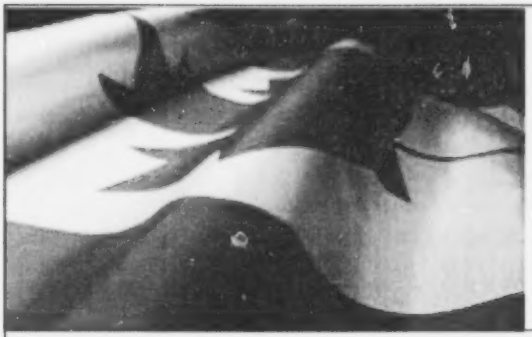

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Equalization and the Incentives for Growth: An Empirical Investigation of the "Tax-Back" Effect

by

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Abstract

Questions have been raised as to whether the equalization payments system in Canada is such that a recipient government's tax and expenditure policies may have a direct effect on the size of its equalization payment. As a result, there has been discussion over the possible links between the equalization program and fiscal decisions made by provincial governments. Specifically, a potential interaction often referred to as the so-called "tax-back" effect has received a great deal of attention, since it points to incentives for inefficient behaviour by provincial governments.

Using vector error correction models of the economies of the six equalization-receiving provinces that received equalization payments without interruption during the 1961-1998 period, as well as a generalized impulse response analysis, the paper explores the dynamics of the interactions between flows of equalization payments and other key variable in the economies of recipient provinces. We find that during the 1963-1998 period Canada's equalization system does not appear to have had an overall negative effect on economic growth.

Résumé

Plusieurs questions ont été soulevées quant à savoir si le système des paiements de péréquation fiscale au Canada est conçu de telle façon que la politique fiscale et la politique des dépenses du gouvernement bénéficiaire peuvent avoir un effet direct sur la subvention de péréquation qui lui sera versée. Par conséquent, les liens possibles entre le programme de péréquation fiscale et les décisions fiscales des gouvernements provinciaux ont suscité beaucoup d'intérêt. Plus particulièrement, mentionnons une des conséquences possibles, soit l'effet de la « récupération fiscale » qui a reçu une attention particulière puisqu'il signale des mesures incitatives pour contrer les comportements inefficaces des gouvernements provinciaux.

En utilisant une représentation autorégressive à correction d'erreurs (VECM) des économies des six provinces qui ont été bénéficiaires de péréquations fiscales sans interruption au cours de la période de 1961 à 1998, ainsi qu'une une analyse des sentiers de réponse dynamique, nous examinons dans ce document la dynamique des interactions entre le roulement des paiements de péréquation fiscale et les autres variables clés de l'économie des provinces bénéficiaires. Nous constatons que, durant la période de 1963 à 1998, le système de péréquation fiscale du Canada ne semble pas avoir eu un effet négatif général sur la croissance économique.

1 Introduction

Questions have been raised as to whether the equalization payments system in Canada is such that a recipient government's tax and expenditure policies may have a direct effect on the size of its equalization grant. As a result, there has been discussion over the possible links between the equalization program and the fiscal decisions made by provincial governments. In particular, a potential interaction often referred to as the so-called "tax-back effect" has received a great deal of attention from academics and the media, since it points to incentives for inefficient behaviour by provincial governments.[1]

Under Canada's representative tax system formula for equalization, increases in a province's own-source revenues may result in equalization entitlements that are lower than in previous years, ceteris paribus. This relative decrease in Equalization payments is described by some as a "taxing-back" of entitlements. In turn, it is argued that this relative decrease in payments creates a potential disincentive for provincial governments to implement policies that would encourage economic growth and increase own-source revenues. The equalization program does not target provincial growth directly, but rather aims to provide provinces with the fiscal capacity needed to provide reasonably comparable public services.

In this paper we explore the relationships between equalization payments, provincial government fiscal policy, and provincial economic growth using vector error correction models of the economies of the six equalization-receiving provinces that received equalization payments without interruption during the 1961-1998 period. The dynamic properties of the model are examined using Generalized Impulse Response analysis, a technique recently proposed by Koop, Pesaran and Potter (1996). Although we cannot, on the basis of such an analysis, either refute or proclaim the existence of any undesirable incentives, we highlight findings that appear to be either consistent or inconsistent with the theoretical predictions of the consequences of a tax-back effect. Our approach can be seen as the first step in an empirical analysis of the tax-back effect, from which many further extensions may arise.

The structure of this paper is as follows. Section 2 provides some background information on Canada's equalization program and the nature of the tax-back effect. In Section 3 we give a detailed description of our empirical framework and model selection procedure. The results of the analysis are presented in section 4. Section 5 concludes and discusses extensions.

2 Background

2.1 The Basics of equalization

Prior to discussing the potential impact of equalization on economic growth incentives, it is important to clearly lay out what the system is intended to accomplish. As stated in section

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[1] See, for example, Courchene (1984, 1994) Dahlby and Wilson (1994), Usher (1995), Smart and Bird (1996), Smart (1998).

36(2) of the Constitution Act, 1982, Canada's system of equalization payments is geared toward a very specific objective: namely, that

> Parliament and the government of Canada are committed to the principle of making equalization payments to ensure that provincial governments have sufficient revenues to provide reasonably comparable levels of public services at reasonably comparable levels of taxation.

Thus, the program is not intended as an economic development program per se, but rather to address the concern that Canadians should have access to reasonably comparable public services whether they live in a recipient or a non-recipient province. The ability of provinces to generate revenues, or their "fiscal capacity", is measured through 33 different tax bases. Equalization provides the means for recipient provinces to enjoy fiscal capacities that are equal to a standard level, based upon national average tax rates. Since provinces determine their own tax policies, the actual amount of revenue they collect can be above or below their actual fiscal capacity as measured under the equalization formula.

Since its inception in 1957, the basic formula of the equalization program has remained the same. However, the calculation of payments is driven by the definition of the standard and the choice of tax bases to be equalized, both of which have changed dramatically over the years. For a full discussion of the history and intricacies of the program, see Courchene (1984, 1994).

2.2 The "Tax-Back" Concept

To begin with, the term "tax-back" itself is a misnomer, since the Equalization system provides payments that may differ across years, but are not "reclaimed" through any tax measure. However, since this term is used frequently by others, it is adopted in this paper for simplicity. The so-called "tax-back" problem then involves the interaction between a province's own-source revenues and its equalization entitlement. If equalization payments were simply a lump-sum transfer from the federal to the provincial governments, they would have an income effect on provincial government behaviour – allowing the provinces to increase spending and/or lower tax rates relative to their levels in the absence of equalization – but would not otherwise be expected to influence provincial decision-making. However, under the representative tax system (RTS) formula used to compute equalization payments in Canada, a provincial government's tax and expenditure policies may have a direct effect not only on its own-source revenues, but also on the size of its equalization grant. Through the normal functioning of the system a province's payments generally decrease when its revenue-raising capacity increases relative to that of the provinces in the standard; thus provincial policies which increase the size of the tax base and thus own-source revenues may also reduce equalization entitlements. Consequently, there has been much discussion over the possible incentives created by the equalization program for the fiscal decisions made by provincial governments.

To illustrate, consider the current formula for equalization. Province j's equalization entitlement for tax base i is computed as

$$E_{ji} = \bar{t}_i (B_{si} - B_{ji}) POP_j \,, \qquad (1)$$

where $\bar{t}_i$ is the national average tax rate, B_{si} is the standard per capita tax base,[2] B_{ji} is province j's own per capita tax base, and POP_j is province j's population. Province j's total equalization entitlement is the sum of its equalization entitlements for all the tax bases included in the program. Only provinces whose total entitlement is positive receive a payment.

Theoretically, the formula may give rise to two classes of incentive problems. The first involves the national average tax rate, and the second the province's own base. We discuss each in turn below, drawing largely from Smart (2001) and Boadway (2001).

Rate Tax-Back

This effect arises from a province's ability to affect the national average tax rate on some or all of the 33 bases. The principal concern is that the design of the system will discourage provinces from attempting to increase their own-source revenues by raising their effective tax rates. If a province's per capita tax base is greater than the standard per capita tax base, then its equalization entitlement will fall if it raises its own tax rates on that base (because the increase in its tax rate will raise the national average tax rate). If the tax base in question is fairly well distributed across provinces, the concern over rate tax-back is nearly moot; the ability of any one province to affect the national average tax rate in this case is very limited. However, if the tax base is highly concentrated in a single province, then the effect becomes more pronounced.

Concern over this situation gave rise to the "generic solution", according to which only 70% of the revenues from a given tax base will be subjected to equalization if 70% or more of that base is concentrated in one of the recipient provinces (i.e. there is a 30% reduction in revenues that are "counted" for the program).[3] Overall, however, the rate tax-back effect is not considered to be of great concern for most provinces and for most tax bases. For provinces whose per capita base is smaller than the standard per capita base, the effect of a tax rate increase is actually the reverse: the equalization entitlement for the base in question will increase if the province raises its average tax rate on the base. Thus for these provinces, the design of the equalization system provides a disincentive to reduce tax rates, albeit likely a small one. In addition, discussions of rate tax-back tend to ignore the possibility that tax bases may be elastic, in which case increases in tax rates might reduce rather than increase own-source revenues. What is clear, though, is that the equalization formula does provide an incentive for provinces to change their tax mix so as to rely more heavily on tax bases for

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[2] The current standard includes Ontario, Quebec, Manitoba, Saskatchewan, and British Columbia.

[3] The generic solution was introduced in 1994, largely to deal with offshore oil and gas revenues that constitute a tax base uniquely concentrated in the Atlantic provinces (onshore oil is a different base). At various times, other bases such as potash in Saskatchewan and asbestos in Quebec have been subject to the generic solution.

which their per capita base lies below the standard per capita base; the extent to which provinces are influenced by this incentive, if at all, remains unknown.

Base Tax-Back

A source of potentially greater concern is the incentive effect arising from a province's control over its own base and the standard base (for those who are included in it). The basic articulation of the problem (see Courchene 1994 among others) points to the overall incentives created. To illustrate, when a given revenue base increases in a recipient province (holding tax rates constant), the reduction in equalization payments equals the change in base times the national average tax rate. If the province's own tax rate is exactly equal to the national average, there is a one-for-one trade-off between own-source revenues and equalization payments for the base in question. If the province's tax rate is below the national average, it loses more than the gain in own-source revenues for that base. If a provincial government cared only about its revenues, this could provide a disincentive to develop resources or take efforts to stimulate the provincial economy, and so create a "cycle of dependency" for recipient provinces. However, most authors concede that there are other "returns" to a province from stimulatory measures, such as the favour of the electorate. This will be elaborated upon later.

2.3 The Debate

Early discussions of rate and base tax-back tended to ignore the interaction between tax rates and the size of the tax base. Smart (1998) refines the above arguments by looking directly at the deadweight loss effects of an RTS equalization system resulting from elastic tax bases. To start, recall that since equalization is not designed to affect a provincial economy directly, "the integrity of the equalization system is based on tax bases being reasonably exogenous [inelastic] " (Boadway 2001;18). However, to some degree tax bases are in fact elastic, and tax rates will affect the size of the base. Without an equalization system in place, provinces bear the full revenue cost if tax rates are set too high. Smart shows that with such a program in place, recipient provinces may have a financial incentive to set tax rates too high. This occurs since equalization transfers increase when a province's tax base declines, in effect partially or fully compensating provinces for the deadweight loss created by high tax rates. In other words, the equalization formula causes provinces to underestimate the distortionary costs of raising tax revenues, i.e. the true marginal cost of public funds (MCPF). Smart's analysis has recently been extended by Dahlby (2001), who shows that an RTS equalization system may also distort a province's expenditure decisions.[4]

It is important to remember that when provinces experience per capita growth in their economies that is faster than the growth of the standard, equalization payments are reduced as part of the normal functioning of the program. Otherwise, a growing provincial economy could still receive payments despite surpassing the performance of non-recipient provinces. What is in question here are the potential distortions that arise from the set of incentives that the system may create. The predictions of theoretical analyses of the tax-back argument can

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[4] As Dahlby (2001) demonstrates, the distortions will tend to be smaller for provinces that are included in the standard

be summarized as follows: (i) the tax rates of recipient provinces will tend to be above the national average, (ii) provinces will change their tax mix so as to rely too heavily on elastic bases (Smart 1998) or on bases which lie below the standard (Dahlby 2001), and (iii) provinces may spend excessively on non-base-enhancing expenditures (Smart 1998) and too little on base-enhancing activities (Dahlby 2001).

However, there are many counter-arguments that suggest that the potential for a significant manifestation of the tax-back effect is limited. As pointed out by Smart (1998, 2001) himself, the income effects generated by the program may reduce the potential for distortions, and thus it is possible to predict the net effect of an RTS equalization program on provincial tax rates only in very restrictive cases. Both Smart (1998) and Dahlby (2001) note that distortions created by other components of fiscal federalism, such as tax competition between provinces or vertical fiscal externalities between levels of government, may offset the tax back effect. Ryan (2001) suggests that because economic development increases population, which in turn increases equalization revenues since entitlements are calculated on a per capita basis, the program may "self-correct". Her calculations of the sensitivity of revenues to population changes suggest that this factor can effectively reverse the incentive for a revenue-maximizing government to suppress economic development. Furthermore, Boadway (2001) points out that many of the major tax bases are indeed fairly inelastic, and so the potential for distortion is highly constrained.

In addition, the current design of the equalization program itself includes a number of provisions that are likely to reduce the disincentives created by the tax-back effect. Certain special clauses in the equalization system, such as the generic solution and offset payments, explicitly serve to reduce distortionary incentives. As well, although alluded to when discussing the incentives for tax shifting, it is not often directly mentioned that provinces have an incentive to *lower* taxes on bases for which their per capita base is greater than that of the standard. Since all provinces are "rich" in some bases and "poor" in others, the overall increase in taxes after any or all shifting is performed may be minimal.[5] In fact, equalization may actually encourage economic development in a province, since payments can act as a sort of insurance against failed initiatives, thus making provinces less risk averse to new ventures that may bring significant economic reward.

Finally, perhaps the most important and often discussed point of contention underlying this debate is the assumption one makes about the objective function of provincial governments. Many academics and government officials assert that provincial governments' decisions are not primarily motivated by the resulting consequences for federal transfers, as they might be if their primary objective was to maximize revenues, but rather are primarily motivated by their constituents' demands for greater economic prosperity. A government that continually neglects economic development opportunities, and so too the job creation that follows, would likely be penalized by the electorate. Thus the tax-back effect may be more of a theoretical possibility than a practical reality if the objective of provincial governments is either to maximize social welfare or to get re-elected. An interesting feature of Smart's (1998) analysis is that it shows that the potential for distortionary tax decisions exists even assuming

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[5] We thank Sean Keenan for pointing this out.

a social welfare-maximizing government.

2.4 The Evidence

While anecdotal evidence regarding the development disincentives of equalization in recipient provinces has been widely discussed in the media, there is little hard evidence to substantiate either view on the subject. The empirical analyses of the tax-back effect that have been published to date rely on simulations of the effect of hypothetical changes in tax bases or tax rates on provinces' equalization entitlements. One of the earliest contributions was by Courchene and Beavis (1973), who show through sensitivity analysis that, particularly for Quebec, heavier taxation on bases for which the province is relatively well-endowed can have a substantial impact on equalization payments. As far as the prediction that recipient provinces' would tend to have higher overall tax rates is concerned, Ryan (2001) has gathered data to refute this, noting that only Newfoundland, Quebec, Manitoba and Saskatchewan currently have aggregate tax rates higher than the national average, while the three Maritime provinces have tax rates below the national average. As well, there is some evidence from empirical work on tax competition that recipient provinces are less responsive than non-recipient provinces to tax rate changes in neighbouring jurisdictions (Hayashi & Boadway 2001, Cavlovic & Jackson 2002), which suggests that equalization may help shield these provinces from the effects of tax competition.

However, to date there has been no econometric analysis of the relationship between equalization and provincial government fiscal policies. Thus there exists no hard empirical evidence on the magnitude of the tax-back effect in Canada. While they are of course valuable, the contributions mentioned above only go part way toward answering the question of interest. It is this void that our research hopes to begin to fill.

3 Empirical Framework

To reiterate, theoretical analyses of the tax-back effect predict that an RTS equalization system could cause recipient provinces to set tax rates too high and will distort both the revenue mix and spending mix of provincial governments. Unfortunately, the large number of revenue bases included in the system renders the development of an econometric model capable of testing all these predictions challenging, to say the least. Instead of following this route, in this paper we focus on the overall effect of equalization incentives on "final" fiscal outcomes, using data on total provincial revenues and expenditures. Such an analysis is of course a worthwhile exercise, since it is indeed the final outcomes that are of greater concern than a particular path of adjustment. Nevertheless, a lack of evidence of distortionary incentives in an analysis carried out at this level of aggregation does not mean the tax-back effect is not a factor in provincial fiscal decisions, but rather that it does not appear to cause distortions once all other factors are taken into account.

Rather than attempting to build a well-defined structural model of provincial fiscal decision-making, in this paper we employ the more atheoretical, data-driven vector autoregression (VAR) approach. Because so much of the concern about the tax-back effect has focused on the incentives for economic growth and development, a dynamic framework would seem to

be appropriate. The lack of a specific structural model means that our analysis should be viewed as descriptive rather than behavioural, or alternatively, as yielding a set of stylized facts about the relationship between equalization payments and other key variables in the economies of recipient provinces. In the remainder of this section we discuss the choice of variables to include in the model, and the results of tests to determine the appropriate dynamic specification of the model.

3.1 Choice of Variables

Since the goal of this study is to examine how equalization affects government behaviour in recipient provinces, we need to include in our model those variables that most parsimoniously characterize provincial government decision-making related to the tax-back effect. Our choice of variables builds upon the framework of Blanchard and Perotti (1999), who look at the dynamic effect of shocks to government spending in the U.S. through a VAR model with three variables: tax revenue, spending and GDP, all in real, per capita terms. This framework would seem to be an appropriate starting point for the analysis of a government's fiscal policy. More importantly for our purposes, to the extent that provincial GDP is a good proxy for a province's tax base, all three variables are implicated in discussions of the tax-back effect. However, in order to examine the tax-back effect we must distinguish between own-source revenues and revenues from equalization. Other transfers from the federal government are also included as a separate variable since they too constitute an important component of provincial government revenue, although they are not directly implicated in the tax-back effect.

Thus we include in our model five endogenous variables for each province: GDP (Y), government spending (S), own-source revenues (R), equalization payments (E), and federal transfers excluding equalization (F). Following Blanchard and Perotti (1999), all variables are measured in per capita terms and converted to natural logs. In addition, because it is unrealistic to regard the provincial economies as closed, we include the unweighted average per capita GDP of the other nine provinces (YO) as an exogenous variable, also converted to natural logs. The effects of U.S. and overseas markets will be partially captured by this variable, especially since Ontario is included in it. Furthermore, our sample ranges back to 1963, when east-west connections were not as overshadowed by north-south trade. Another advantage of including this variable is that it helps to control for the relative position of a province in the Canadian economy, which is important with regard to the calculation of equalization entitlements.[6]

Although direct *federal*, as opposed to provincial, spending in a province may have an impact on the provincial economy, it is not included in the model. It is excluded for two reasons:

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[6] We experimented with including other exogenous variables, such as US GDP, and the GDP of provinces included in the standard, in the model. Due to serious constraints on degrees of freedom, it is impractical to include two exogenous variables. Moreover, results did not differ markedly when US GDP was used in place of the GDP of "other" provinces. Thus, our choice of variable seemed the best compromise between parsimony and accuracy. Tests for weak exogeneity were performed to justify including the "open economy" variable as exogenous. Indeed, we accepted weak exogeneity of this variable for most but not all provinces. However, since these tests are known to have poor small sample properties, we adopted the specification that a priori seemed most relevant.

first, because it is not a provincial government policy instrument, and second, because the time series available is not long enough for us to safely include any more variables in an unrestricted VAR or vector error correction (VEC) model. Only if we were to place some restrictions on the variables entering each equation of the model could we consider adding more variables to the model as a whole.

All the data are drawn from the Provincial Economic Accounts (PEA), available through Statistics Canada's CANSIM database, and are available for the period 1961-1998.[7] The PEA data are available only on an annual basis. Data were collected for each of the six provinces that received equalization payments without interruption during the 1961-1998 period: Manitoba, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.[8] These six provinces are more likely than non-recipient provinces to be vulnerable to the tax-back effect, since equalization payments constitute an important share of provincial government revenue in these provinces.[9] To provide a point of comparison, a modified model that excludes equalization payments was estimated for Ontario, a non-recipient province.

Only GDP data were collected for all ten provinces. For each recipient province and Ontario, own-source revenues are defined as total provincial revenues from direct and indirect taxation, net of transfers from the federal government. Similarly, spending (S) is comprised of total current expenditures on goods and services by provincial and local governments, as well as transfers to persons and business or government entities. Transfers between the provincial and local governments are netted out. Interest on the public debt has not been netted out of S, since even though it is not a discretionary expenditure it is an important spending category.[10]

The two remaining endogenous variables are the two categories of intergovernmental transfers. Data on actual equalization payments made in a given calendar year do not appear as a separate category in the PEA, but rather are included under the heading "taxation agreements." Also included in this category are any prior-year adjustment payments, stabilization payments, and a special public utilities income tax adjustment applicable to Alberta. Although these are not insignificant payments, they are a small percentage of the total. For this reason, and to ensure consistency with the data for the other variables, we use

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[7] More detailed information on data sources can be found in Appendix 1. The data were obtained from two sets of Provincial Economic Accounts (PEA) data that were non-continuous over the sample period (1961-1991, and 1981 to 1998). A linking formula was applied which used the growth rate of the historical series to extend the current one backwards, in order to better justify merging the series. In any case, differences between the historical and current series were minimal.

[8] Recently the province of Newfoundland changed its official name to Newfoundland and Labrador. In the remainder of the paper, we will sometimes abbreviate this province's name to Newfoundland.

[9] The province of Saskatchewan also received equalization payments throughout most of the sample period. However, for several years in the early 1980s Saskatchewan's equalization entitlement fell to zero, and any payments received in those years reflected adjustments to previous years' payments. Because of this switch from recipient to non-recipient status in the middle of the sample period, we decided to exclude Saskatchewan from our analysis.

[10] Blanchard and Perotti (1999) exclude transfers to persons and interest payments from both revenues and expenditures.

these data as a proxy for equalization payments.[11] Other federal transfers were computed as total transfers to the provinces less the amounts included under "taxation agreements." This variable is largely comprised of payments under the Canada Health and Social Transfer (CHST) program and its precursors.

The last variable of the model, real per capita GDP in the other nine provinces, was computed by taking the unweighted average across the other nine provinces of per capita GDP. It and the other variables of the model were converted to real terms using the national GDP deflator, since provincial GDP deflators are not available from Statistics Canada for the entire sample period. All the endogenous and exogenous variables were then transformed by taking the natural log.

It is important to note that although many changes to the structure of intergovernmental transfer payments occurred during the sample period, we do not explicitly model these changes. One possibility might have been to add dummy variables to reflect these changes. However, using dummy variables to account for major changes in the equalization system would be equivalent to treating these changes as exogenous events. Instead, we are in effect treating all the changes that occurred during the sample period, including changes in the definition of the standard tax base and changes in the number of bases subject to equalization, as endogenous to the system. To the extent that changes were indeed made in response to the functioning of the system, this may be a more reasonable assumption than assuming all changes to be completely exogenous.

3.2 Model Specification

For the most part, the software package used to test and estimate the provincial models was MALCOLM (Maximum Likelihood analysis of Cointegrated Linear Models), which is embedded within RATS.[12] A separate model was estimated for each province that had received equalization payments throughout the sample period: Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, and Manitoba. The dynamic specification chosen was similar but not identical for each of the six provinces.

Choosing the appropriate specification for a multivariate dynamic model involves several steps. The first is to test for the presence of unit roots in the variables of the model. If all the variables are trend-stationary, then the appropriate specification for the dynamic system would be a VAR model in the original variables. If the variables instead are difference stationary (have a unit root), then the appropriate specification would be either a VAR model in first differences or a VEC model, depending on whether the variables are cointegrated or not.

To test for the presence of unit roots in all of the variables, we apply the Augmented Dickey-Fuller (ADF) test, using Campbell and Perron's (1991) lag selection procedure to determine the appropriate number of augmentation terms to add. As all variables displayed a

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[11] Working with equalization entitlements as opposed to payments would yield a different set of problems, thus we have accepted the margin of error inherent in working with payments.
[12] See Mosconi (1998) for a guide to MALCOLM.

slight upward trend, the test in levels was carried out with a linear trend included in the test equation. Theoretically one would expect all the variables except perhaps equalization payments to be trending upwards over time.[13] The results are reported in table 1. Most of the variables in levels appear to be integrated of order 1 (I(1)), with the exception of per capita own-source revenues and per capita equalization payments in the case of Quebec. Once first differenced, all of the variables are found to be I(0) at the 10% level of significance or less, and so it is appropriate to test for cointegration.[14]

Table 1: Augmented Dickey-Fuller Unit Root Test Applied to Variables

Levels						
Variable	Manitoba	Quebec	N.B.	N.S.	P.E.I.	N&L
Y	-2.2031	-2.4143	-2.6354	-1.3809	-0.8670	-1.6963
F	-1.7066	-2.0662	-2.0971	-1.4464	-1.6499	-2.5449
R	-3.1969	-3.6283 **	-1.9348	-2.0673	-3.0547	-2.1111
E	-0.3385	-3.8965 **	-1.7566	-1.6898	-1.3864	-2.2553
S	0.5684	-1.5276	-0.6078	-0.5181	-0.9917	-1.3094
YO	-1.3431	-1.5012	-1.3665	-2.0071	-1.3855	-1.3834

First Differences						
Variable	Manitoba	Quebec	N.B.	N.S.	P.E.I.	N&L
Y	-6.0366 ***	-3.8225 **	-7.6417 ***	-5.1397 ***	-1.6623 *	-7.4254 ***
F	-4.6751 ***	-5.0397 ***	-6.3493 ***	-5.0582 ***	-7.5320 ***	-8.6215 ***
R	-3.0822 **	-3.4756 **	-5.1613 ***	-5.8952 ***	-6.8432 ***	-5.5724 ***
E	-4.1682 ***	-2.1154 **	-7.0833 ***	-6.2176 ***	-6.6037 ***	-8.4104 ***
S	-3.0138 **	-4.6110 ***	-4.1454 ***	-4.0770 ***	-8.5482 ***	-1.6222 *
YO	-4.5297 ***	-4.9342 ***	-4.5426 ***	-4.5354 ***	-4.5629 ***	-4.5681 ***

Notes: When applied to the levels, augmented Dickey-Fuller (ADF) test statistics are computed using a constant and a linear time trend. When applied to the first differences, the test statistics computed with a constant, with the exception of the following variables: E(Quebec), Y(PEI), and S(Newf). S(Quebec) in first differences is calculated with a constant and trend. The ***, **, and *, indicate that the null hypothesis of a unit root could be rejected at the 1%, 5% and 10% critical levels, respectively. For all tests, the order of augmentation was chosen by Campbell and Perron's (1991) lag selection procedure. These tests were performed in EViews.

Before testing for cointegration, a lag length for the dynamic system must be chosen. Tests for lag length were based on the following unrestricted VAR model:

$$x_t = \alpha + \sum_{i=1}^{k} \Phi_i x_{t-i} + \sum_{i=1}^{k} \psi_i yo_{t-i} + \varepsilon_t \ , \qquad (2)$$

[13] Because per capita equalization payments depend on a province's relative economic performance, they should decline as the province moves closer to the Canadian average.

where x_t is the 5x1 vector of endogenous variables, α is a 5x1 vector of constant terms, yo_t is the average per capita GDP of the other nine provinces, k is the lag length or order of the VAR, Φ_i and ψ_i, $i = 1, \ldots, k$, are 5x5 and 5x1 matrices of coefficients respectively, and ε_t is a 5x1 vector of random errors. Because our models include a total of six variables (we allow the exogenous variable to enter each model with the same number of lags as the endogenous variables) and only 38 observations are available in the data set, our choice of lag length is severely restricted. Although standard information criteria suggested that a longer lag length might be appropriate, we chose to restrict the lag length to two for all provinces.[15] This choice of lag length leaves us with a sample of 36 observations, covering the period 1963-1998, for estimation. While our choice of lag length is arbitrary, Hjelm (2001) concludes that two lags are sufficient for his model of the dynamic effects of fiscal policy in the United States, also estimated using annual data. On the other hand, Bleaney et al. (2001) find that in endogenous growth models, the long-run effects of fiscal policy take longer than five years to become evident (they choose a lag length of eight years). They also note that the issue of whether longer lags are necessary when modelling fiscal variables is under-researched. Unfortunately, our data constraints do not allow us to explore longer lag lengths.[16]

If in fact the variables of the model are cointegrated, then the appropriate specification of the model is not equation (2) above, but rather a VEC model of the general form

$$\Delta x_t = \sum_{i=1}^{k-1} \Gamma_{x,i} \Delta x_{t-i} + \sum_{i=1}^{k-1} \Gamma_{yo,i} \Delta yo_{t-i} + \mu_0 + \mu_1 t + \alpha \beta_x' x_{t-1} + \alpha \beta_{yo}' yo_{t-1} + \varepsilon_t \quad (3)$$

where Δx_t and Δyo_t are first-differences of x_t and yo_t, μ_0 is a 5x1 vector of constant terms, t is a linear deterministic trend, μ_1 is a 5x1 vector of coefficients, β_x and β_{yo} are matrices of cointegrating vectors, α is a 5xr matrix of loading factors, r is the number of cointegrating equations, and $\Gamma_{x,i}$ and $\Gamma_{yo,i}$ are 5x5 and 5x1 matrices of coefficients. In contrast to a VAR model, a VEC model implies that shocks to the system will have permanent rather than temporary effects. Johansen's trace test was used to test for cointegration.[17] Asymptotic critical values calculated by MacKinnon et al. (1999) that are valid in the presence of exogenous variables were used. These critical values are purported to be the most accurate available. The test was applied to a basic specification that included unrestricted intercepts and restricted trend coefficients,[18] which implies a linear trend in both the I(0) and I(1)

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[14] Although it was once considered necessary for all variables within a cointegrated system to be of the same order of integration, this has been shown to be false under certain conditions. See Charemza & Deadman (1997, 126-7).

[15] When the maximum lag length is set equal to four, the Akaike information criterion always suggests a lag length of four. The Schwartz criterion also suggests a lag length of four for three of the six provinces, but only one lag for the other three. However, only 7 degrees of freedom would remain for each equation if four lags of each variable were included. When the maximum lag length is set equal to two, both criteria suggest a lag length of one for four provinces.

[16] Bleaney et al. (2001) are able to explore this question because they pool time-series and cross-section data for a number of countries.

[17] According to Mosconi (1998, 16) only Johansen's trace test, not his lambda max test, gives rise to a coherent testing strategy. Furthermore, Garratt et al. 2001 argue that it is more robust than the lambda max test.

[18] Different authors have used different names for the cases of treatments of deterministic elements, so confusion easily arises. In the context of Pesaran, Shin and Smith (2000) we are using Case IV, which in Malcolm is referred to as Model 4. However, in Osterwald-Lenum (1992) this case is called Case 2*. Note also

components of the VECM. This set of assumptions about the deterministic elements seemed most consistent with our data, and according to Pesaran and Smith (1998) is one of the most relevant in practice of the five cases commonly discussed.[19]

The results of the cointegration tests are presented in table 2. Given our assumption about the appropriate combination of constants and trends, the trace tests showed that the variables for all provinces were indeed cointegrated, but that the cointegration rank differed across provinces, ranging from 1 for Newfoundland to 3 for Manitoba and Nova Scotia. Conseqently, the appropriate specification of the model for each province is a VEC model of the form (3), but the dimensions of the matrices α and β will be different for different provinces. Because we have no model upon which to base a structural interpretation of these cointegrating (or long-run) relationships, we have no reason to impose restrictions upon them and therefore do not test any hypotheses about the cointegrating vectors. A standard normalization is necessarily imposed by the estimation algorithm, but this normalization does not affect the impulse responses that we discuss in the next section.

Table 2: Cointegration Rank Statistics by Province

		Test Statistic						95% Critical
H_0	H_1	Manitoba	Quebec	N.B.	N.S.	P.E.I.	N&L	Value
r = 0	r ≥1	122.83	116.68	140.36	139.74	135.24	130.32	100.29
r = 1	r ≥=2	84.86	73.55	89.32	88.99	87.24	71.48 *	73.31
r = 2	r ≥=3	50.88	41.57 *	43.76 *	50.85	49.38 *	43.82	50.25
r = 3	r ≥=4	26.08 *	21.33	25.22	26.07 *	26.81	20.06	31.05
r = 4	r ≥=5	10.37	7.38	10.22	10.31	10.22	6.37	15.46

Notes: The underlying VAR is of order 2. The test statistic is Johansen's log-likelihood-based trace test. Asymptotic critical values are taken from MacKinnon et al. (1999) using Case IV with one exogenous variable Performing the test sequentially from r=o…p-1(=4), a * indicates when the null is not rejected for the first time, thus determining the rank. It should also be noted that the rank test for Newfoundland and Labrador was very close to accepting a rank of 2, but nevertheless we used the strict result that r =1, despite it being unlike other provinces and somewhat surprising intuitively (one would imagine more than one long-run equation). Qualitatively, the results for either case are quite similar.

4 Results

Impulse response analysis is one of the principal tools used to explore the interrelationships between variables in a multi-equation dynamic model. Impulse response analyses are

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that two of the remaining cases do not correspond to each other in the presence of exogenous variables (see MacKinnon et al. (1999).

[19] Likehood ratio tests for restrictions on the deterministic trend coefficients were performed, and Case IV was accepted over Case III (the only realistic alternative) for Manitoba, Quebec, New Brunswick and Newfoundland and Labrador. However, Case III was accepted over Case IV for Nova Scotia and PEI. We employed Case IV for all provinces, since we are working with data known to have a trend.

simulations in which the error terms of each equation are shocked in turn; the effects of the shock are then allowed to feed through the dynamic system. The problem with impulse response analysis is that the results are often difficult to interpret, since VAR and VEC models are usually viewed as reduced-form systems with no exogenous variables. The error terms in each of the VAR equations are thus functions of the errors of all the equations of the underlying, unobserved structural model, and it is not clear what shocks to these reduced-form errors represent.

The initial response to this problem, proposed by Sims (1980), was to assume a recursive form for the underlying structural model, which involves using a Choleski decomposition of the variance-covariance matrix of the model's innovations in impulse response analysis. However, in most cases the assumption of a recursive structure is unlikely to be consistent with reality. Consequently, only if the variance-covariance matrix of the VAR system is diagonal will the impulse responses be independent of the ordering of the variables in the model.

Dissatisfaction with the approach of assuming orthogonal errors in the underlying structural model led to the development of structural VAR analysis. Structural VAR analysis involves using additional information, say about the structural relationships between the variables, or information about the availability of data, to identify the underlying structural errors of the model. Impulse response analysis is then carried out by shocking the structural errors, not the reduced-form errors. The impulse responses can then be readily interpreted as the result of shocks to specific variables. The problem with this approach is that it is always possible to question the assumptions used to identify the structure of the model, particularly since this structure is imposed only on the variance-covariance matrix of the estimated model and not on the estimating equations themselves.

More recently, Koop, Pesaran and Shin (1996) have proposed a new alternative to both orthogonalized impulse response analysis and structural VAR analysis, called Generalized Impulse Response analysis. Detailed formulas for the calculation of generalized impulse responses and their asymptotic covariance matrices are provided in Pesaran and Shin (1998). Generalized Impulse Response (GIR) analysis does not attempt to impose any structure on the model, but instead takes into account the estimated correlations between the error terms in computing impulse responses. These correlations imply that a shock to one reduced-form equation will affect all the equations of the model simultaneously, although the effect on each equation will differ.

It is important for proper analysis of the results to be clear about the information that a GIR conveys. First, since it is the reduced-form errors that are being subjected to shocks, we cannot be sure of the exact source of the shock to any particular reduced-form equation. However, the framework does take into account the fact that all variables affect each other contemporaneously. Second, GIRs are invariant to the ordering of the variables of the model (Pesaran and Shin 1998). This is an important feature for our analysis, since we are constrained to using annual data, where contemporaneous relationships are likely important and do not lend themselves to a clear causal ordering. Third, a GIR describes the time profile of the effect of a one standard deviation shock to a particular equation on the endogenous variables of the model. A GIR does not show the response of a model to structural shocks, but rather provides "a meaningful characterization of the dynamic

responses of the macroeconomy to 'realistic' shocks (meaning shocks of the type that are typically observed)" (Garratt et al. 2000, 13). Thus GIR functions are often described as taking account of the historical patterns of correlations observed amongst different shocks. For this reason, Agénor et al. (1998) argue that GIR analysis is particularly well suited to studying the "stylized facts" underlying a data set, and are a fruitful reconsideration of what impulse response analysis is really meant to uncover.[20]

It should be noted that if the covariance matrix of residuals is diagonal, a Choleski decomposition is no longer sensitive to the ordering of the endogenous variables, rendering the use of an orthogonalized impulse response less problematic. Likelihood ratio tests for a diagonal covariance matrix showed that only in the case of Manitoba were we unable to reject the null hypothesis of a diagonal covariance matrix.[21] When comparing the orthogonal and the generalized impulse responses, we observed that indeed for Manitoba the two sets of responses were nearly identical. For the other provinces, the impulse responses generated by the two methods did display some noticeable differences.

It must be reiterated that although it may be tempting to think in terms of structural shocks to the system, that with a GIR we have opted to look at the historical shocks *as they have been seen to feed through the system.* The GIR can thus be viewed as an examination of the time path of a typical historical shock, as opposed to a specific historical shock. In addition, given the GIR framework, it is particularly useful to look at responses collectively rather than at a particular response in isolation. Thus in the discussion that follows, we look at the simultaneous effects of each shock on several variables. However, we focus on those GIRs that seem to us to be most relevant to the tax-back effect.[22] In particular, we are looking for any evidence that the existence of equalization may have caused recipient provinces to adopt fiscal policies that have a negative effect on their tax base, as measured by per capita GDP. It is worth noting that only two of the six provinces examined, Quebec and Manitoba, are included in the standard throughout the sample period. Thus it is of interest to compare the character of their responses to those of the Atlantic provinces.

The GIRs we deem relevant to the tax-back effect are presented in figures 1 to 15. To facilitate comparisons between provinces, each figure presents a single GIR for all six provinces under consideration. The values on the vertical axis in each diagram are the changes in logs, and can be multiplied by 100 to obtain the approximate percentage change. Asymptotic 95% confidence bands are also shown in each diagram.[23] All shocks to the reduced-form errors are positive and of one standard deviation in magnitude.

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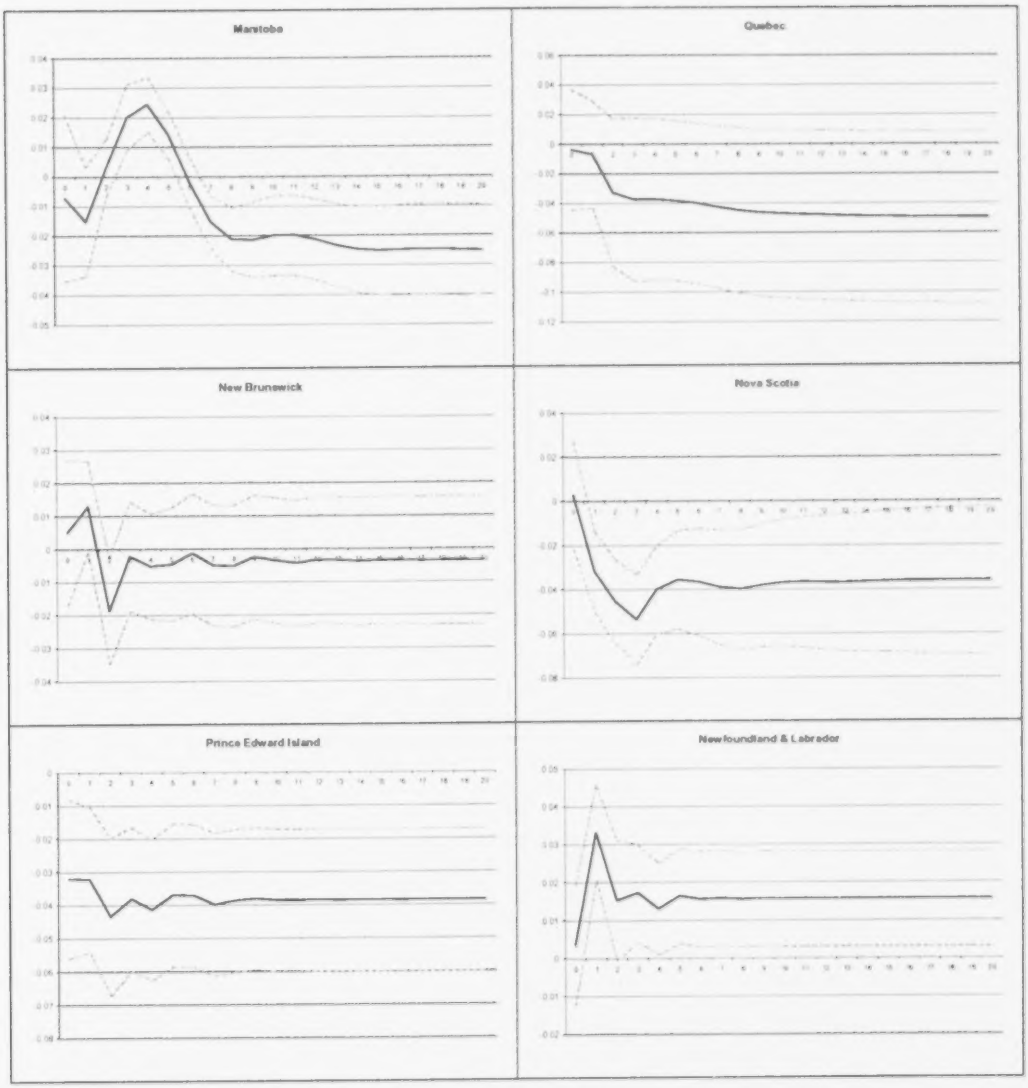
[20] Other recent applications of GIR analysis include Garratt et al. (2001), Ewing (2001),and Hjelm (2001).

[21] The likelihood ratio test statistics were as follows: Manitoba, 8.354; Newfoundland, 22.193; Nova Scotia, 30.489; Quebec, 33.816; New Brunswick, 19.498; and Prince Edward Island, 20.811. The 95% critical value for 10 degrees of freedom is 18.31. Therefore we reject the null hypothesis of a diagonal covariance matrix for all provinces except Manitoba.

[22] A complete set of impulse responses is available from the authors upon request.

[23] Other authors, including Garratt et al. (2001), Agenor et al. (1998), and Hjelm (2001) use bootstrap confidence bands rather than asymptotic confidence bands. However, recently Killian (1998), Benkwitz et al. (2000), and Benkwitz et al. (2001) have provided evidence that neither asymptotic nor bootstrap confidence intervals for impulse responses in VAR and VEC systems are very reliable. While Killian proposes a modified bootstrap procedure for VAR models, Benkwitz et al. (2000) suggest that the proposed modifications may not always be successful. Furthermore, as Garratt et al. (2001) point out, little work has been done on the reliability

Figure 1. Response of E to Y



of confidence intervals for impulse responses in large VAR models with cointegration, while Killian's (1998) results for a bivariate VEC model with drift actually suggest that that the differences between the reliability of different means of computing the confidence intervals are relatively small in this case. Our decision to use asymptotic confidence intervals was based primarily on convenience.

Figure 2. Response of Y to Y

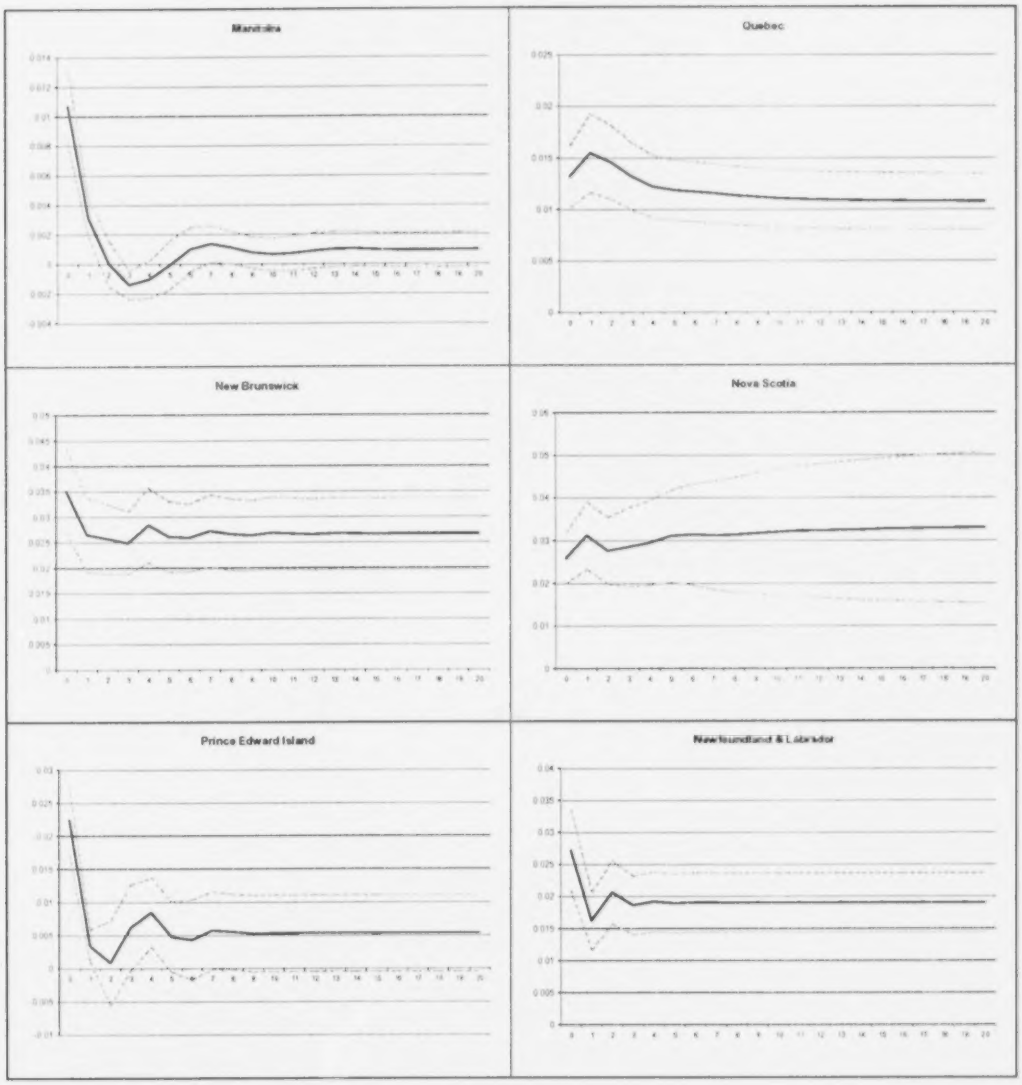
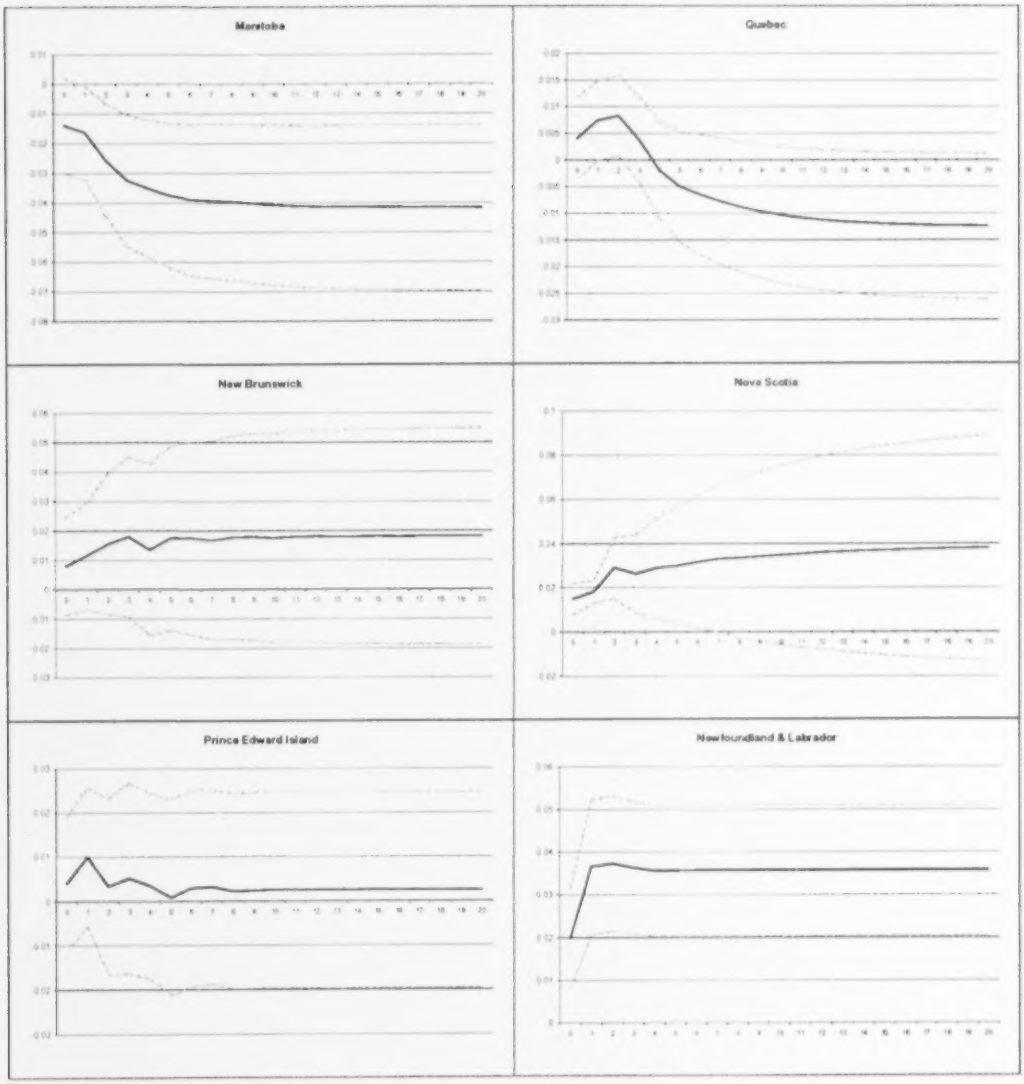


Figure 3. Response of R to Y



4.1 Shocks to the Y Equation

Under the normal functioning of the equalization formula, improvements in a province's economic performance relative to that of the other provinces should lead to a reduction in its equalization payments. Since per capita GDP in the other provinces is an exogenous variable in our model, it is held constant when other variables are subjected to shocks. Thus insofar as per capita GDP is a good proxy for provincial tax bases, we would expect a positive shock to the Y equation to give rise to a negative response in equalization payments

in the long run. Indeed, figure 1 shows that with the exception of Newfoundland and Labrador, this is generally the case, although in Quebec and New Brunswick the long-run effect does not seem to be statistically significant. In Manitoba, the results suggest a long-run drop in equalization payments of about 2.5%, while in both Nova Scotia and Prince Edward Island the long-run decrease in equalization is closer to 4%.

Interestingly, the initial impact effect on equalization of the shock to the Y equation is positive (although insignificant) in Nova Scotia as well as in Newfoundland, while in Manitoba the negative impact of the shock is translated into a positive effect on equalization three to five years after the shock. The temporary positive effect of the shock in Manitoba is likely related to the fact that as shown in figure 2, the shock also causes per capita output decreases two to four years after the initial impact.

These results suggest that with the possible exception of Newfoundland, during the period covered by the analysis the equalization system has been functioning as one would expect. One possible explanation for why a long-run increase in output of almost 2% should be accompanied by a 1.5% increase in equalization payments in Newfoundland is that during the sample period, increases in GDP in this province may have occurred primarily in tax bases not subject to equalization.[24] Another possible explanation can be found in figure 3, which shows the response of revenues to the shock to the Y equation. This figure indicates that Newfoundland is the only province in which the shock to the Y equation results in a significantly positive increase in per capita own-source revenues. Moreover, the percentage change in revenues is greater than the percentage change in GDP, implying that average tax rates must have increased over the period of the simulation.[25] If the tax rate increases were large enough and were imposed on bases for which Newfoundland lay below the standard, it may have been sufficient to offset the effect on equalization of the increase in per capita GDP, our proxy for the tax base.

4.2 Shocks to the Spending Equation

One of the predictions of theoretical analyses of the tax-back effect is that too much government spending will be directed towards activities that do not enhance the growth of tax bases. Because we include only aggregate spending in the model we cannot address this question directly, but we can look at the overall effect of shocks to the spending equation on both GDP per capita and equalization payments. A finding that shocks to the spending equation lead to decreases in per capita GDP accompanied by increases in per capita equalization payments would certainly be cause for concern.

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[24] Although nearly all provincial revenue sources are currently captured by the equalization program, coverage was less complete during the early part of the sample period.

[25] The model estimated for Ontario was similar to that estimated for the recipient provinces, except that it includes only four endogenous variables since Ontario did not receive equalization payments during the 1963-1998 period. Only two lags were used, although again there was some evidence suggesting that a longer lag length might be more appropriate. Johansen's trace test implied two cointegrating vectors for Ontario. More detailed results for Ontario are available from the authors upon request.

Figure 4 shows that the long-run effect of a typical one standard deviation shock to the spending equation on per capita spending itself is positive and significant in all six provinces considered. However, figure 5 indicates that contrary to what one might expect, shocks to the spending equation do not lead to important increases in GDP per capita in five of the six recipient provinces examined. Instead, in Manitoba and Quebec both the short-run and long-run effects of the shock on GDP per capita are negative. In New Brunswick and Prince Edward Island the impact effect of the shock is negative, but not significantly different from zero. While the long-run effect is positive in four provinces – New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland – in three of these four provinces the positive effect is small (less than 1%) or insignificant. Only in Nova Scotia is the effect of the shock strongly positive, rising from about 0.5% to almost 5% after twenty years. The negative long-run effects in Manitoba and Quebec of the shock to the spending equation are small – no more than 0.5% – but they are statistically significant.

The response of equalization per capita to this shock, presented in figure 6, is generally much larger than the response of output. In all provinces real equalization payments per capita rise by between 1% and 6.5%, with the increase being statistically significant in all provinces except Prince Edward Island and Quebec. Thus it would seem that except in the case of Nova Scotia, shocks to the spending equation have typically resulted in long-run increases in equalization per capita but little or no increase in GDP per capita. In Manitoba, GDP per capita actually decreases by a small amount as a result of the shock, while per capita equalization payments rise by more than 2%.

Do these results indicate that the recipient provinces have been paying less attention to economic growth than to increasing equalization payments? How can we explain them given that there is no direct link between equalization and provincial government spending through the equalization formula? The latter question is the easiest to address. Part of the answer lies in the fact that in our reduced-form models lagged spending and equalization payments do in fact enter each other's equations directly. The estimated coefficients of these lagged variables reflect the relationship between spending, own-source revenues, equalization and the other variables of the model during the sample period. The period between 1963 and the early nineties was marked by an important expansion of the provincial/local government sector in Canada. Throughout this period, provincial governments increased spending, and raised tax rates in order to finance much of the increased spending. The resulting increases in average tax rates raised the national average tax rate and thereby contributed to increases in equalization entitlements independently of changes in the position of provinces relative to the equalization standard.[26]

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[26] We thank Sean Keenan for pointing out this interpretation of the results.

Figure 4. Response of S to S

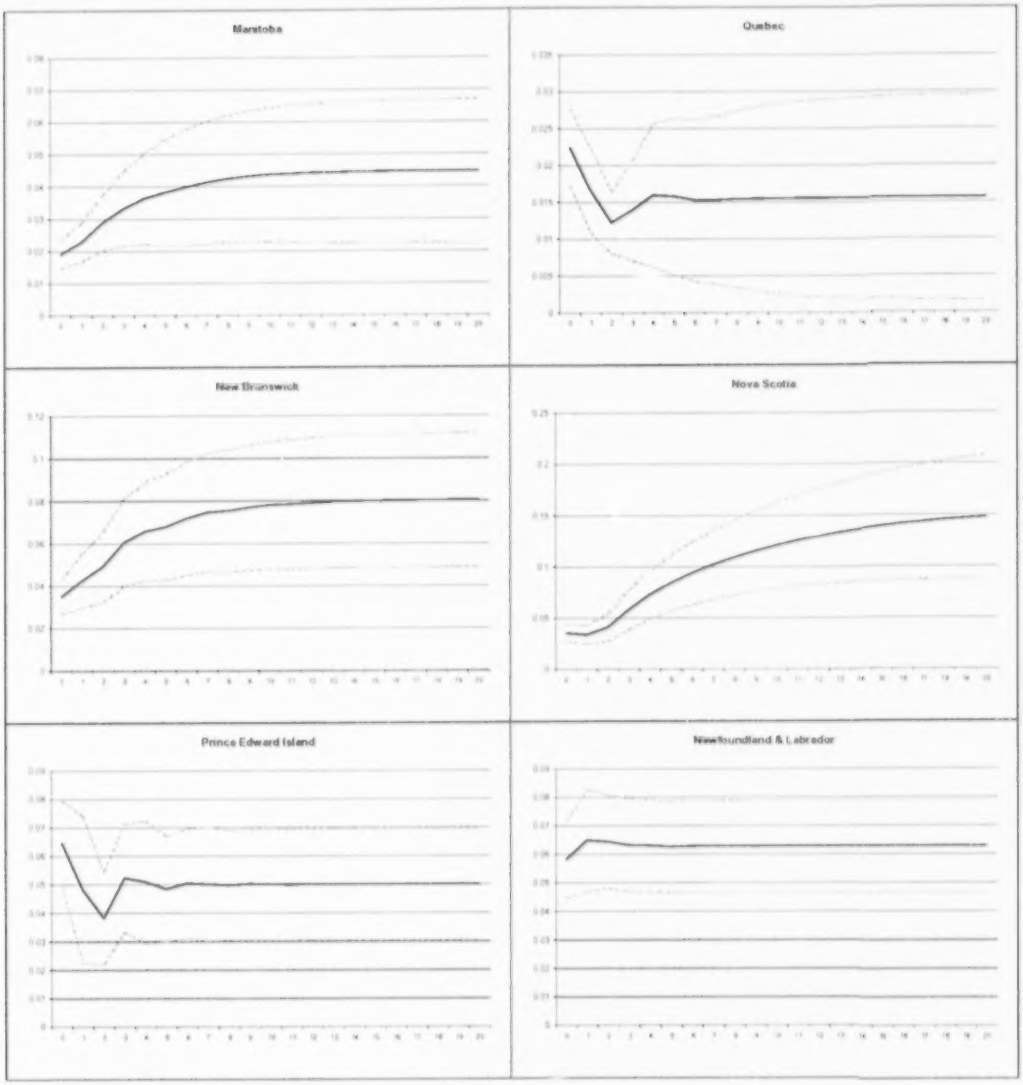


Figure 5. Response of Y to S

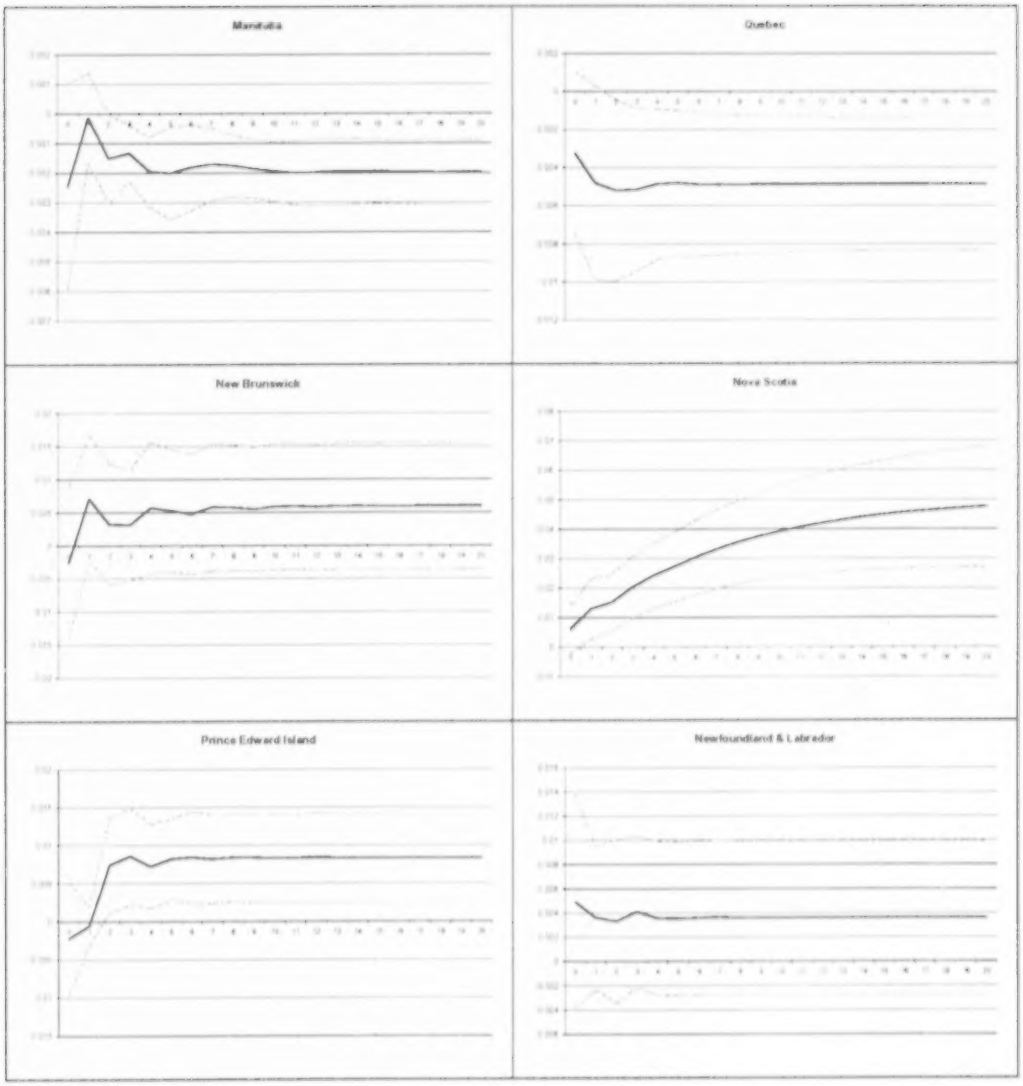


Figure 6. Response of E to S

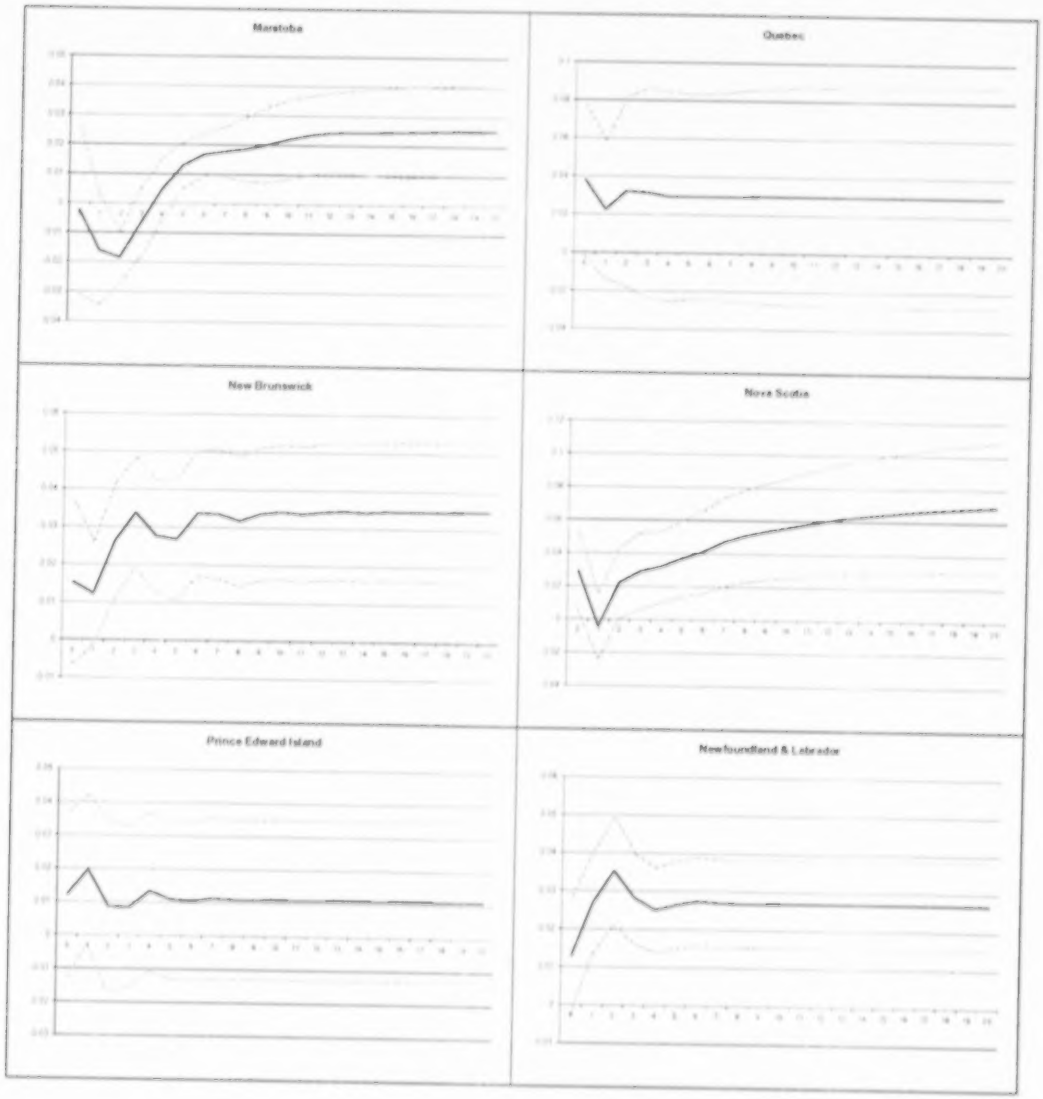
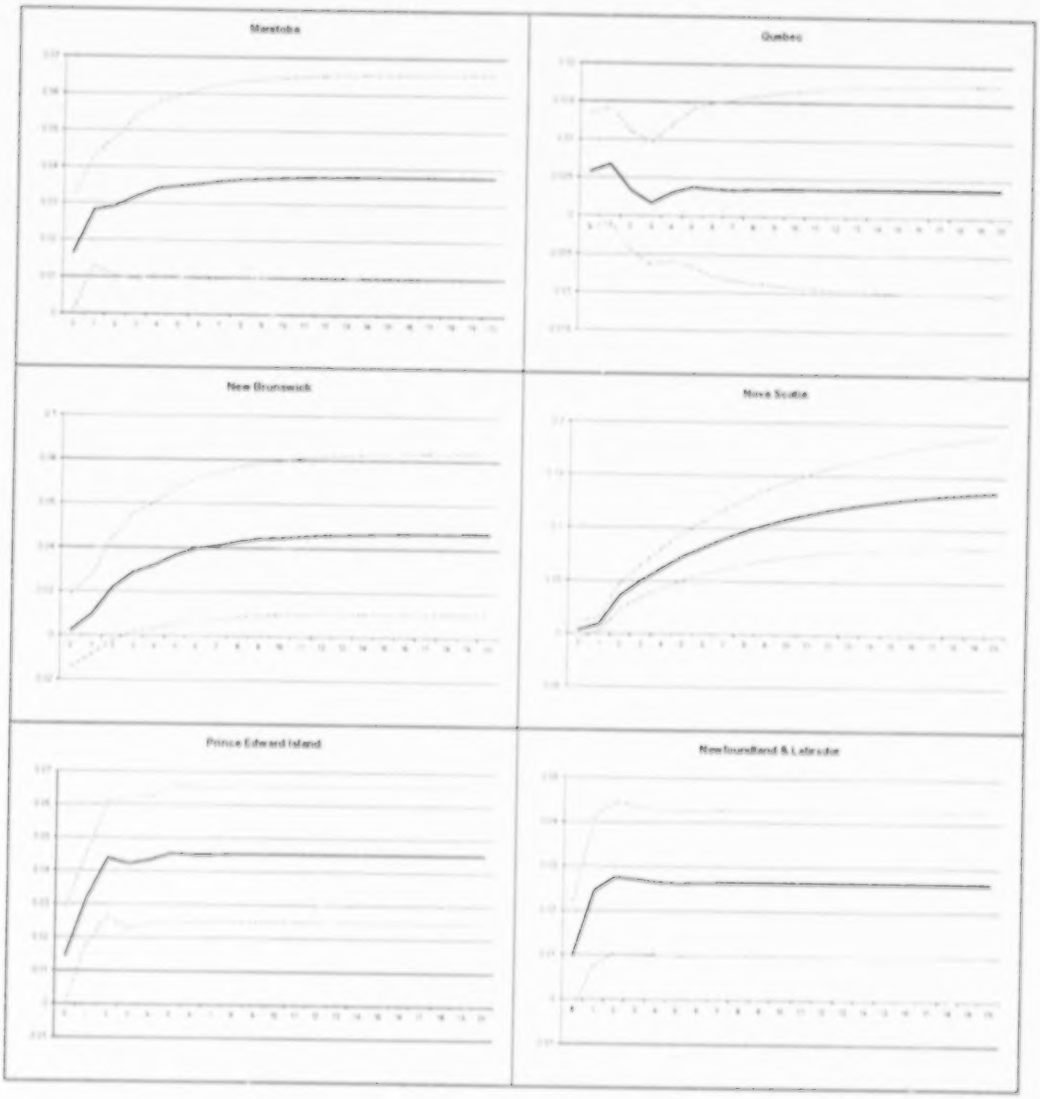


Figure 7. Response of R to S



Indeed, as figure 7 illustrates, the shock to the spending equation leads to a statistically significant increase in per capita own-source revenues in all provinces except Quebec. Moreover, as a comparison between figures 5 and 7 indicates, the percentage change in own-source revenues is always larger than that in per capita GDP (which is negative or insignificantly different from zero in three of the six provinces). This observation suggests that average tax rates do indeed increase in all six provinces as a result of the shock to the

spending equation.[27] This increase in average tax rates, which contributes to an increase in the national average tax rate for equalization purposes, is likely responsible for the observed increase in per capita equalization payments resulting from the shock. The long-run increase in own-source revenues is most pronounced in Nova Scotia, where the gap between the percentage increase in revenues and GDP is about nine percentage points.

As to whether or not the results provide some evidence in favour of the existence of undesirable incentive effects, it would be somewhat hasty to jump to such a conclusion on the basis of the simple models estimated here. We cannot rule out the possibility that the models do not include enough lags to capture all the long-run effects of government spending on the economy. But we also cannot rule out the possibility that consistent with a tax-back effect, some provinces may indeed have devoted too large a share of their spending over the 1963-1998 period to functions that do not lead directly to increases in their tax bases. What we can say is that the striking differences between the effects of shocks to the spending equation in Manitoba, Nova Scotia, and the other four recipient provinces are worthy of further study.

As a final note, it is interesting to compare the expenditure equation shocks for these six provinces to those for one of the non-recipient provinces, Ontario. Selected results for Ontario are presented in figure 8. In the case of Ontario, shocks to the spending equation are always correlated with positive output effects, leading to a long-run increase in GDP per capita of approximately 2%. Of the six recipient provinces, only Nova Scotia enjoys a larger increase in per capita GDP as a result of a shock to the spending equation. Furthermore, the percentage increase in own-source revenues in Ontario exceeds the percentage increase in GDP, implying an increase in average tax rates in that province also. But as is the case in Nova Scotia, this increase in average tax rates does not seem to have offset the expansionary effects of the spending increase on economic growth in the long run.

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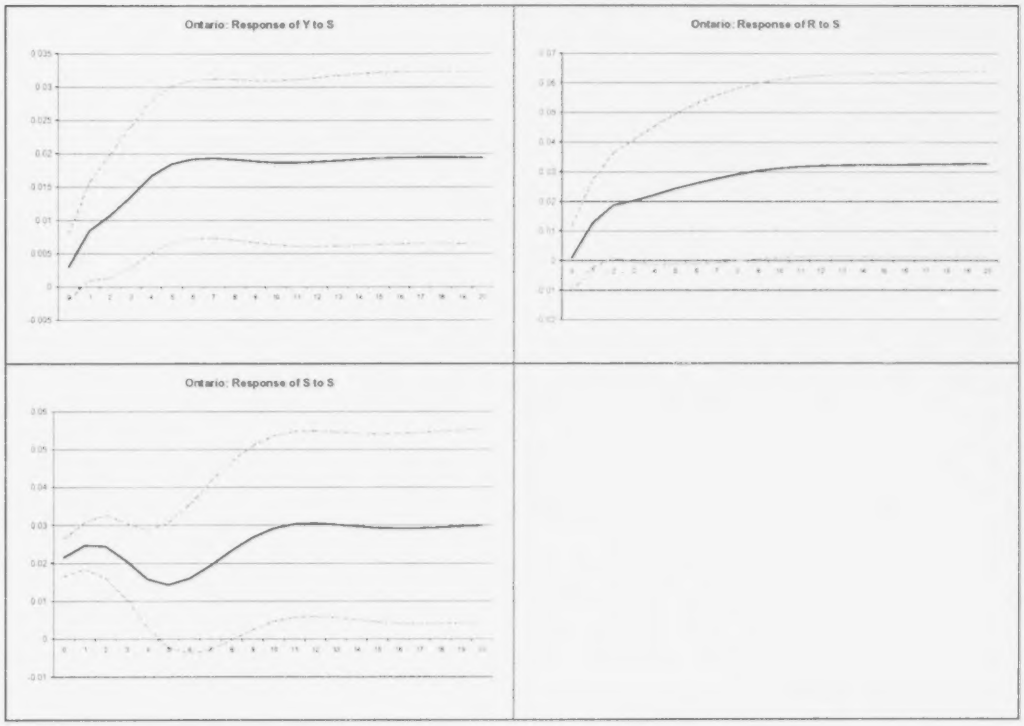
[27] In discrete terms, the percentage change in own-source revenues between periods t and t-1 can be expressed as $\frac{\Delta R_t}{R_{t-1}} = \frac{\Delta t_t}{t_{t-1}} \frac{Y_t}{Y_{t-1}} + \frac{\Delta Y_t}{Y_{t-1}}$, where R is own-source revenues, Y is the tax base (GDP), and t is the average tax rate. The ratio Y_t/Y_{t-1} will always be positive, implying that the percentage change in revenues can exceed the percentage change in GDP only if there is a positive percentage change in average tax rates as well.

Figure 8. Selected Generalized Impulse Responses for Ontario



4.3 Shocks to the Revenues Equation

Another prediction of theoretical analyses of the tax-back effect is that recipient provinces may tend to set their tax rates at above-average levels. Again, our model does not allow us to directly address that question since we use total own-source revenues as an endogenous variable rather than the average tax rate. Increases in own-source revenues may come about as a result of increases in the tax base or increases in average tax rates, and we cannot look at the two independently. However, looking at the effect of a positive shock to the own-source revenues equation on GDP per capita can help us to determine whether historically, increases in own-source revenues have been primarily due to base increases or tax rate increases. If a shock to the own-source revenues equation that increases per capita own-source revenues in the long run is accompanied by a decrease in GDP per capita, our proxy for the aggregate tax base, that would suggest that the increase in revenues was primarily due to an increase in average tax rates. If instead both own-source revenues and GDP increase as a result of the shock, one can still conclude that average tax rates must have increased if the percentage change in revenues is greater than the percentage change in GDP.

In fact, as figure 9 illustrates, shocks to the revenue equation lead to *increases* in per capita GDP in all provinces, although the long-run increase is not significantly different from zero in Manitoba, Quebec, and Nova Scotia. In those provinces where the effect is significant it ranges from about 0.6% (Newfoundland and Labrador) to about 1.5% (Prince Edward

Island). These results seem somewhat surprising; typically one would expect a negative or neutral response to a revenue shock rather than a positive one. However, it should be reiterated that the shocks we are examining are not structural shocks; instead, what the results are telling us is that positive shocks to own-source revenues have historically been associated with increases in GDP per capita as well, perhaps because of the associated positive effects on other variables in the model. As in the case of shocks to the spending equation, it is also possible that the model includes too few lags to pick up the full effect of the shock.

Turning now to the long-run effects of the shock to the revenues equation on per capita own-source revenues themselves, figure 10 shows that there is a significant increase in own-source revenues in all provinces except Nova Scotia. Moreover, the percentage increase in own-source revenues exceeds that of GDP per capita in Manitoba, Quebec, Prince Edward Island, and Newfoundland, implying a long-run increase in average tax rates in those provinces. The results for New Brunswick suggest little or no increase in average tax rates in that province, while average tax rates actually appear to decrease in Nova Scotia. Thus overall there is evidence that in four of the six provinces, the long-run increase in revenues resulting from a typical shock to the revenue equation has been driven more by increases in average tax rates than by increases in the tax base. The relatively small response of output as average tax rates have risen further suggests that the aggregate tax base is not highly elastic. If so, then the tax-back effect may be less detrimental than many observers fear.

Because the tax-back effect is concerned with the link between own-source revenues and equalization, the response of per capita equalization payments to a shock to the revenues equation may also tell us something about the importance of the tax-back effect. If the tax back effect has been important during the 1963-1998 period, then we would likely see a negative response of equalization payments to the revenue equation shock.[28] Instead, as shown in figure 11, we observe a negative (and insignificant) impact effect only in Manitoba and in Newfoundland and Labrador. The long-run effect of the shock is positive in all six provinces except Nova Scotia. In the three provinces for which the positive long-run effect on equalization per capita is significant, it is also large, ranging from slightly over 4% in Nova Scotia to over 12% in Quebec. In the cases of Manitoba and Quebec, the long-run percentage increase in equalization per capita is actually greater than that in per capita own-source revenues.

Thus there is no evidence that the tax-back effect has had a substantial impact on the budget constraints of the provincial governments of Manitoba, Quebec, New Brunswick, Prince Edward Island, and Newfoundland. Instead, own-source revenues and equalization payments have tended to increase together in these provinces. Of course, we cannot rule out the possibility that these provinces were shifting tax effort to either new bases, or bases for which they are below the standard, so as to increase own-source revenues without reducing equalization payments. If so, then the equalization program is still having some impact on provincial revenue decisions, although not the negative effect on their bottom line that many observers feared.

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[28] Recall that increases in own-source revenues can be accompanied by increases in equalization payments if the revenue increase is the result of a tax rate increase on a base for which the province is below the standard.

Figure 9. Response of Y to R

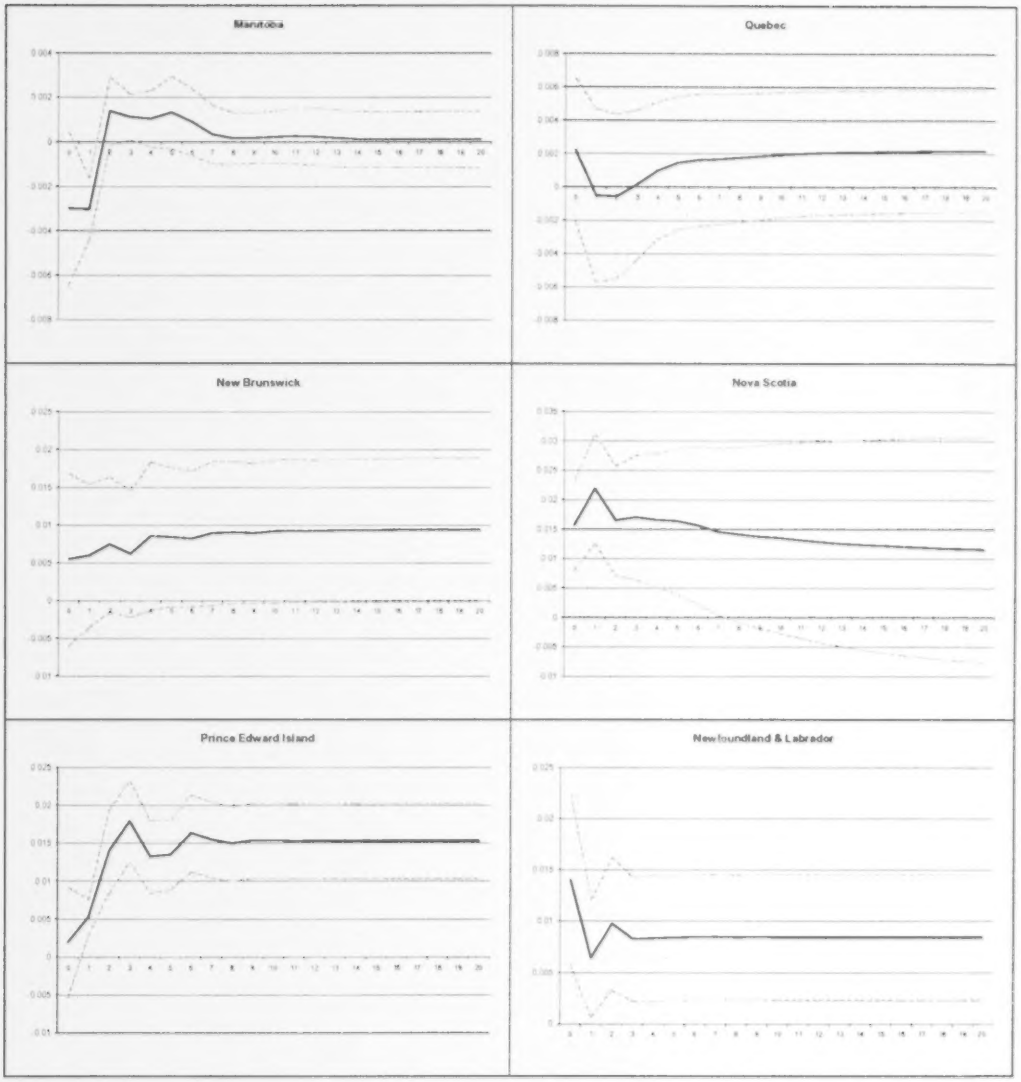


Figure 10. Response of R to R

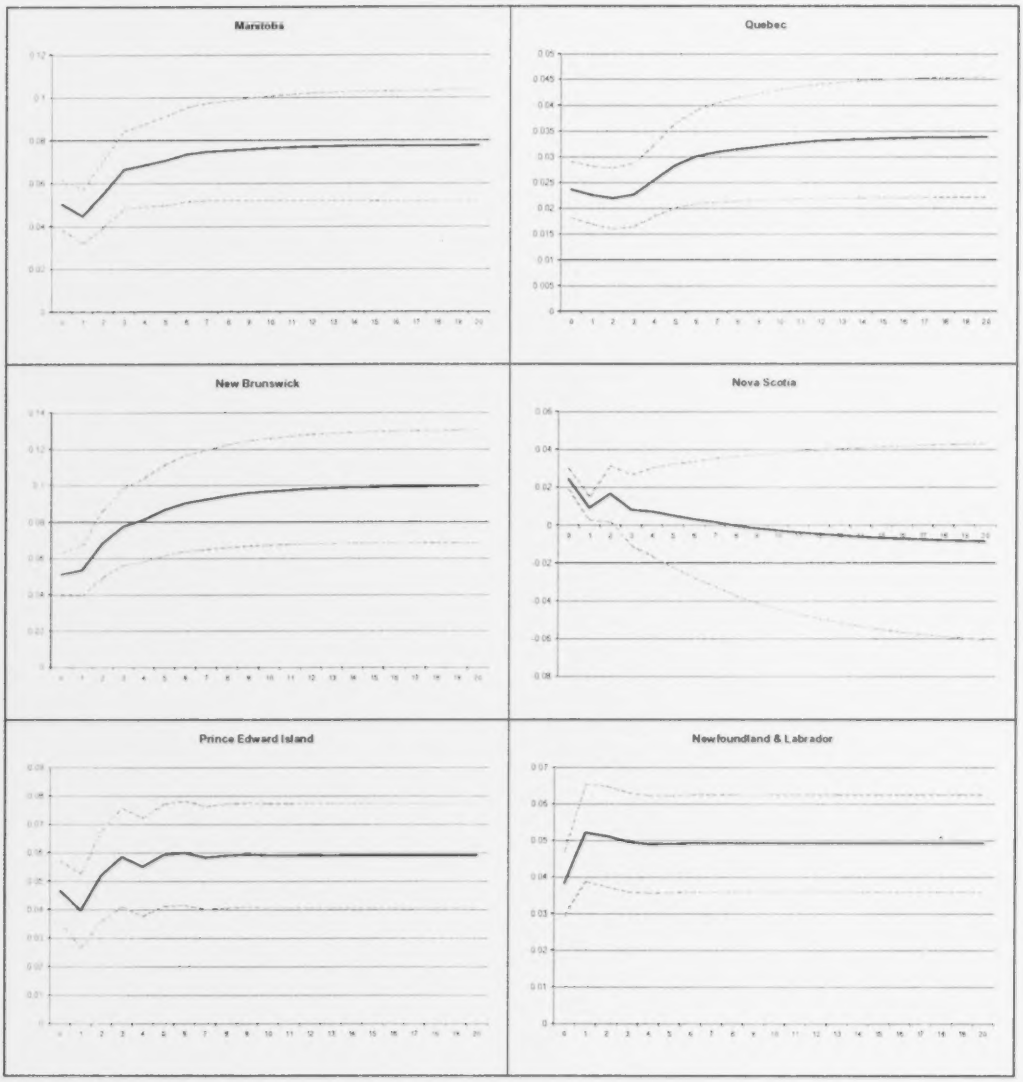
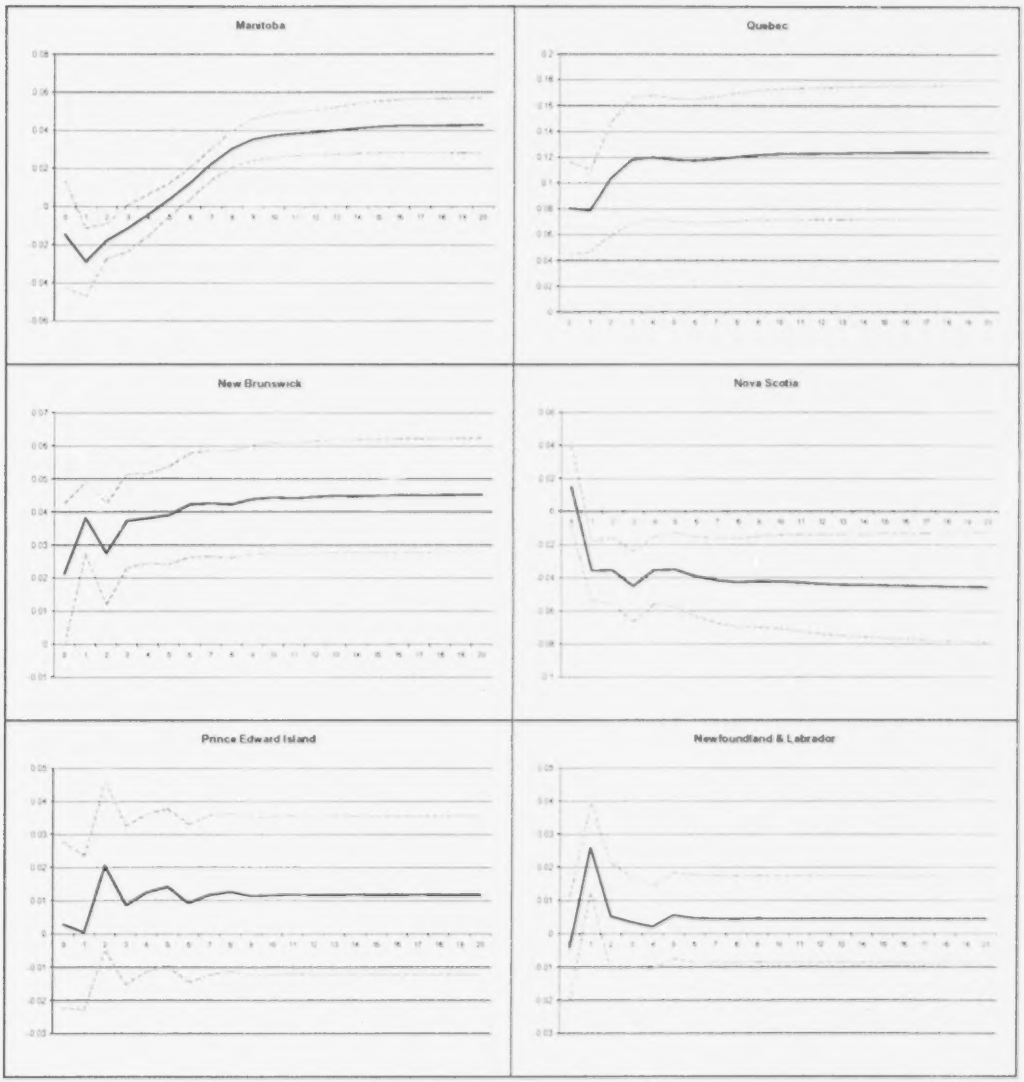


Figure 11. Response of E to R



The one province that stands out with respect to its response to a shock to the own-source revenues equation is Nova Scotia. In this province the positive shock to the revenues equation has initially a positive effect on equalization payments, but ultimately results in a decrease of over 4% in per capita equalization payments. Nova Scotia is also the only province for which the positive revenue equation shock does not lead to a significant permanent increase in revenues. Instead, per capita own-source revenues actually decline by about 1% in the long run, despite the fact that the increase in GDP per capita remains positive (but insignificant). This result – a positive revenue shock leading to long-run

decreases in both own-source revenues and equalization – is not consistent with the tax-back effect either, since no clear trade-off between equalization and own-source revenues is observed.

4.4 Shocks to the E Equation

A look at the responses of own-source revenues, spending, and GDP per capita to a shock in the equalization equation can also tell us something about the importance of the tax-back effect. In our reduced-form model, a number of different factors may contribute to positive shocks to the error term in the equalization equation: the inclusion of new tax bases in the equalization program, changes in the definition of the standard, an increase in the tax rate on a base for which the province is below the standard, and even a negative structural shock to the tax base (GDP per capita), among other things. The exact effects on own-source revenues, spending, and GDP per capita of such a shock to the reduced-form error are likely to depend on the nature of the factors driving the shock. If the shock consists of a favourable (to the recipient province) change in the equalization program, then the income effect of the change would likely cause provincial governments to increase their spending and/or decrease their revenues by lowering tax rates. A deviation from this result – in particular, an increase in revenues – would suggest that the incentive effects of equalization (essentially substitution effects) outweigh the income effect. In this case it would be difficult to predict the overall effect on GDP per capita. If the reduced-form equalization shocks have been driven primarily by negative shocks to provincial GDP per capita, again one would likely observe a decrease in revenues, accompanied (at least initially) by a decrease in GDP per capita. Per capita spending may or may not decrease as well, depending on the extent to which the provincial government engages in counter-cyclical policy.

Turning now to the results, figures 12 and 13 show that own-source revenues and spending respond in the same direction to the shock to the equalization equation in both the short run and the long run in all provinces except Newfoundland. In Newfoundland, own-source revenues decrease while spending increases, as would be consistent with a dominant income effect, but neither effect is large or statistically significant. In New Brunswick and Quebec, both revenues and spending increase significantly in the long run, with slightly larger percentage increases in revenues than in spending. Figure 14 shows that in three provinces – Manitoba, Quebec, and Prince Edward Island – the initial impact on GDP is negative, suggesting that negative shocks to GDP may play a role, but the effect is not statistically significant.

Manitoba's responses to the equalization equation shock stand out from those of all the other provinces. Not only is it the only province in which the positive equalization equation shock is associated with decreases in both spending and revenues, as figure 15 illustrates it is also the only province in which the shock had a negative long-run impact on per capita equalization payments. In the other five provinces the long-run effect on equalization payments is positive. The decrease in equalization payments in Manitoba observed in figure 15 is consistent with the small but statistically significant long-run increase in GDP per capita in that province observed in figure 14.

The implications of these results with respect to the tax-back effect are somewhat mixed. While the increases in spending are consistent with the income effect of equalization, the increases in revenues are perhaps more consistent with provinces raising their tax rates on bases for which they are below the standard. A comparison of the percentage change in revenues with the percentage change in GDP implies that the overall average tax rate must have increased over the period of the simulation in several provinces, especially Quebec and New Brunswick. This, too, is consistent with theoretical predictions of the incentive effects of equalization. According to the tax-back argument, an increase in equalization would exacerbate the underestimation of the MCPF, and thus heighten the incentive to raise tax rates. However, the results for Manitoba, where revenues and average tax rates appear to decrease, are clearly inconsistent with a tax-back effect.

Figure 12. Response of R to E

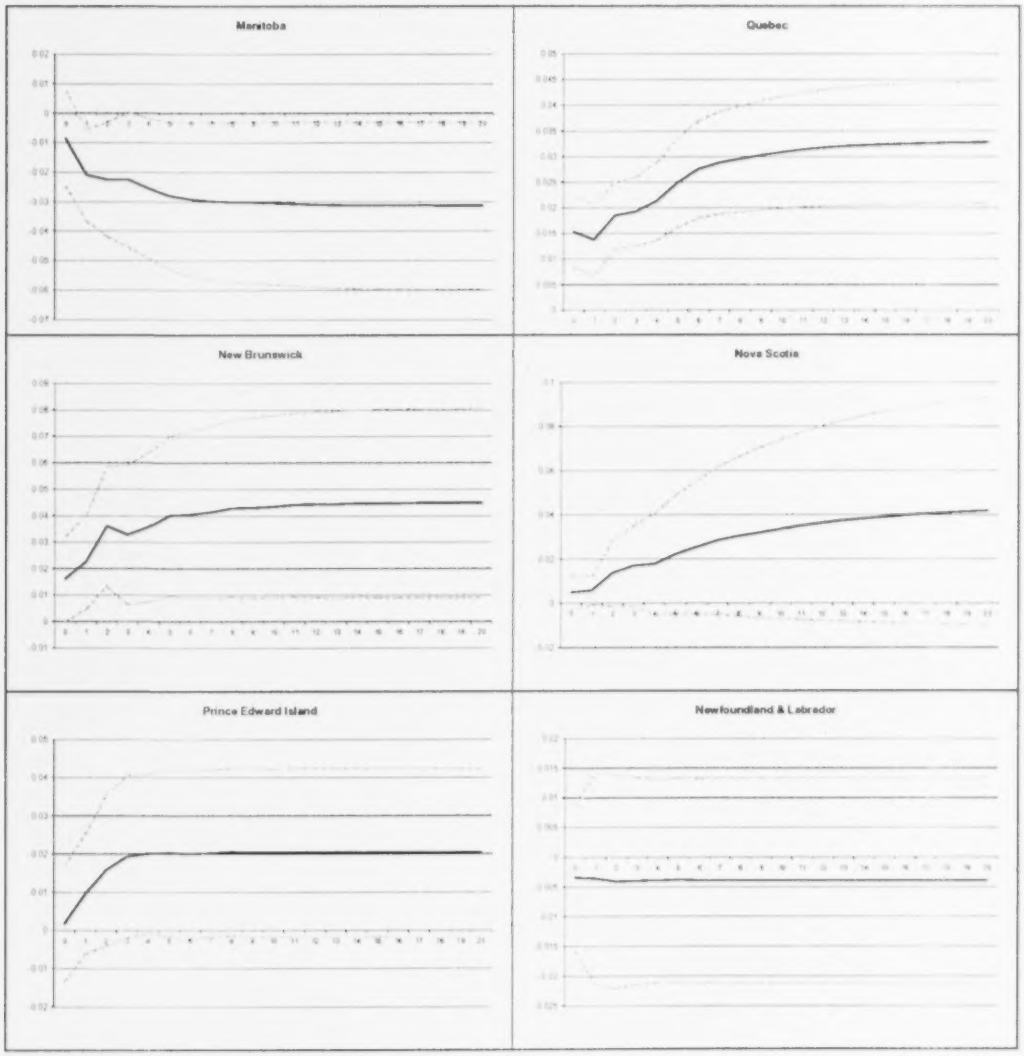


Figure 13. Response of S to E

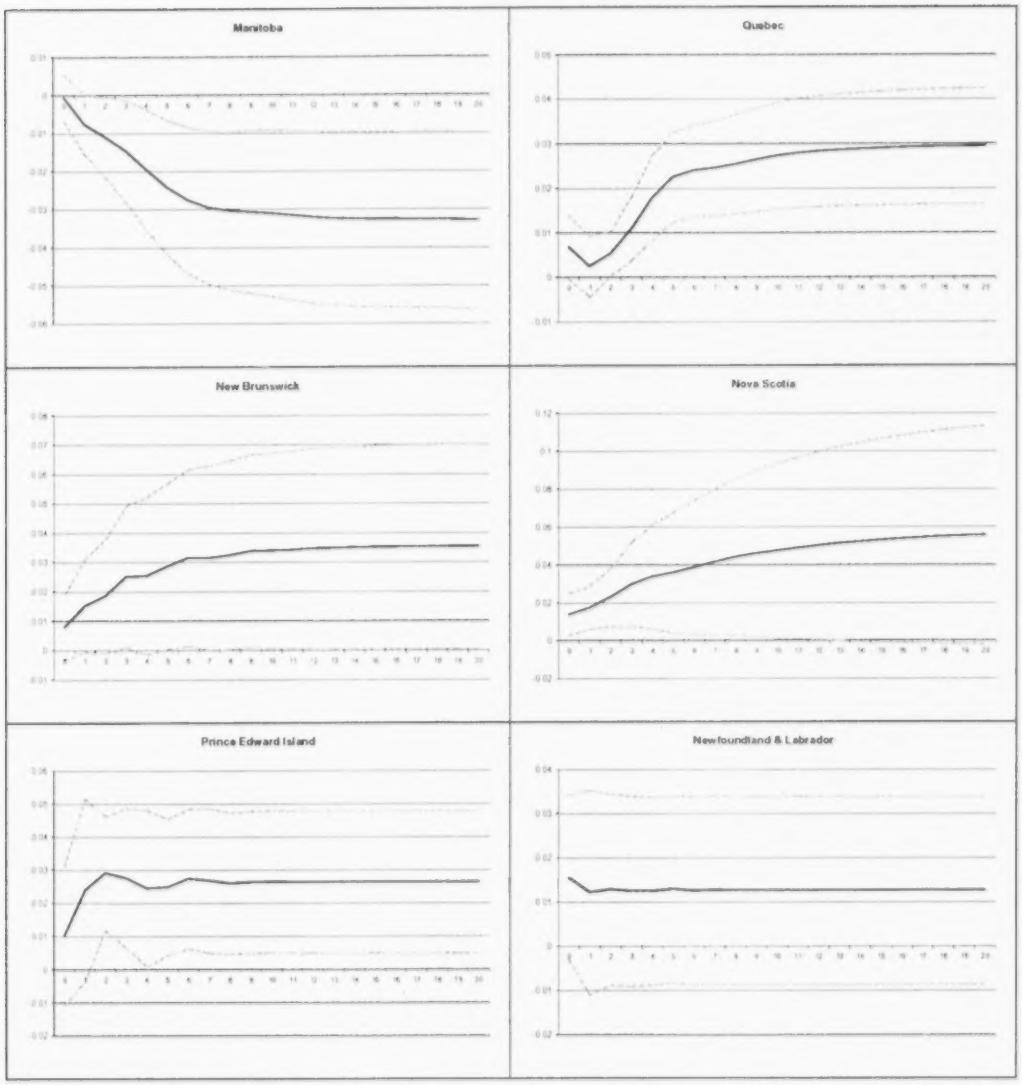


Figure 14. Response of Y to E

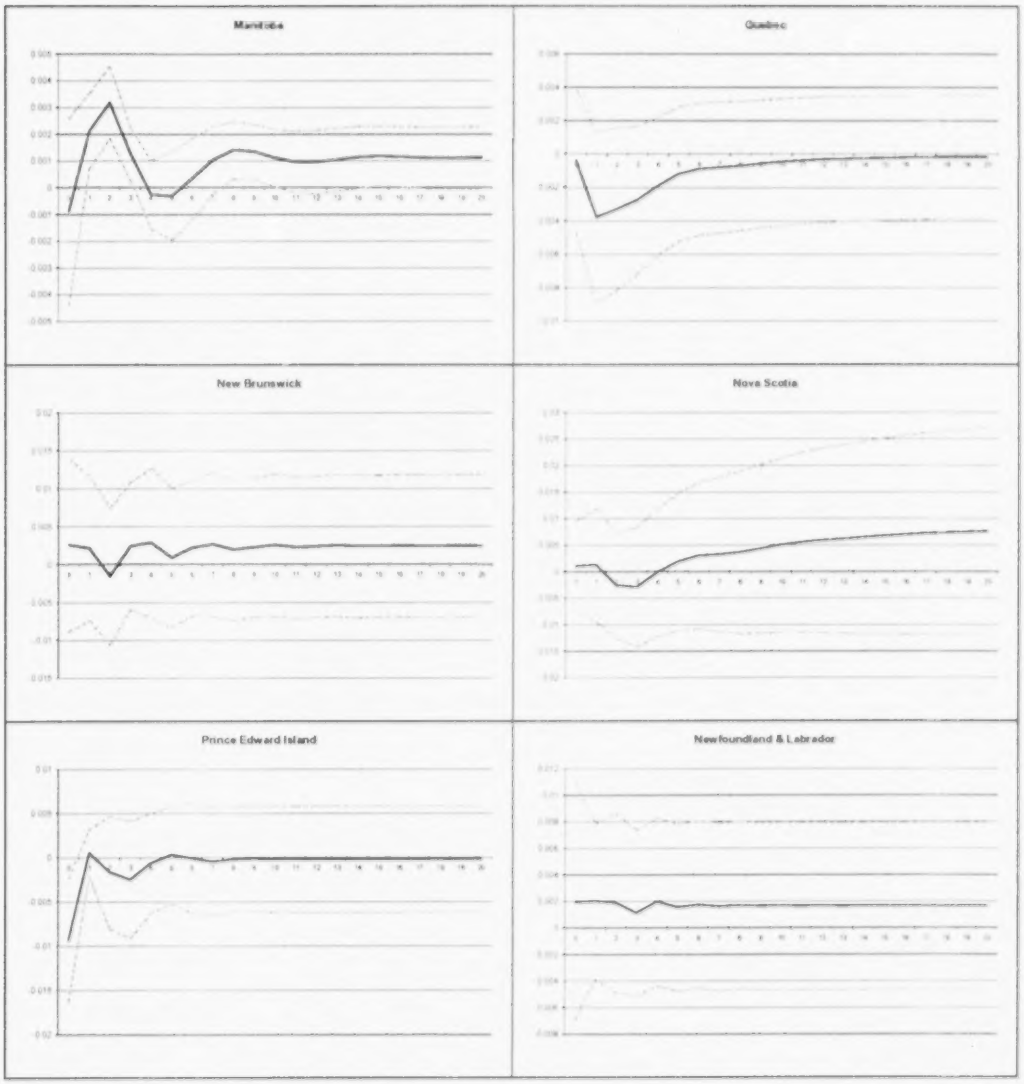
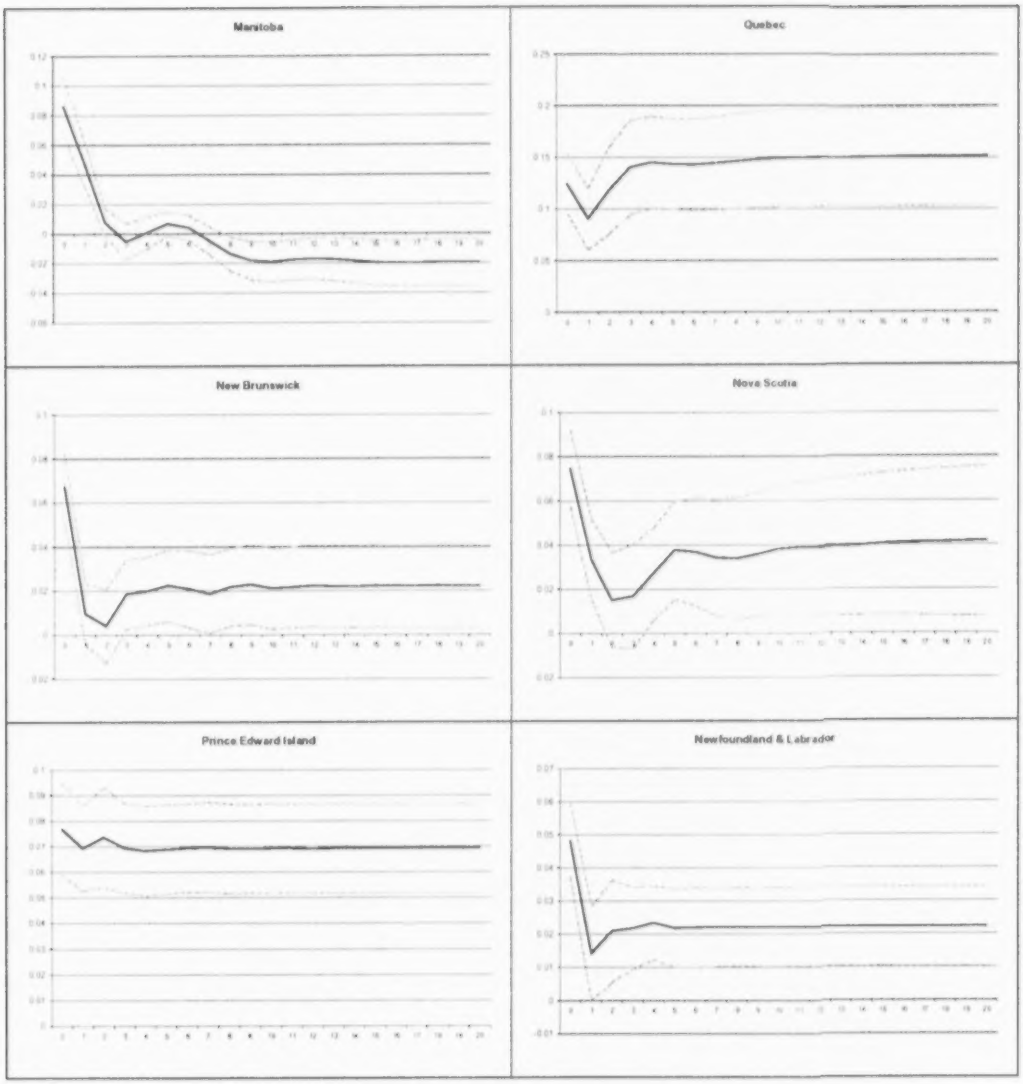


Figure 15. Response of E to E



The response of per capita GDP to shocks to the equalization equation is of particular interest because we can interpret it as a measure of the "overall effect" of equalization on the provincial economies. In other words, it is ultimately this dynamic that is of primary concern, since a negative long-run effect would suggest that tax-back distortions are indeed operational and having a negative impact on provincial economies. In the absence of a tax-back effect, there is no reason to expect either increases or decreases in GDP as a result of shocks to the equalization equation, since as noted earlier equalization is not targeted towards GDP growth. Figure 14 shows that in fact, a shock to the equalization equation in most cases leads to a positive response in per capita GDP in the long run. In Quebec the

response is initially negative, but insignificant and very small (0.4%). The only significant long-run response is seen in Manitoba, but the increase in per capita GDP is only about 0.1%.

Of course, these graphs do not tell us anything about the nature of the growth in the provincial economies, nor about the effect of the equalization equation shock on some measure of potential output. What they do show is that no alarm bells need immediately be raised; if tax-back distortions were in full effect, with damaging consequences on provincial economies, we would expect an overall effect to be picked up here. Instead, with the exception of the Manitoba case, it appears that equalization equation shocks have had no significant impact on output in the recipient provinces examined here.

Finally, it is interesting to note that there are important differences between provinces in the effect of a shock to the equalization equation on per capita equalization itself, as figure 15 demonstrates. Most notably, the long-run response in Quebec, an increase of 15%, is much larger than in any other province. The Atlantic provinces all display much smaller positive responses, with the possible exception of Prince Edward Island at 7%. In Manitoba, the results suggest that the positive equalization shock leads to a long-run decrease of 2% in equalization payments. The persistence of an equalization shock can be explained by policy choices at either the federal or provincial level, but our empirical framework does not allow us to distinguish between the two.[29]

5 Conclusions

While on paper the equalization formula seems simple enough, predicting its effects on provincial government behaviour is not an easy task. For any given tax base, the effect on equalization entitlements of an increase in that per capita tax base will depend on the province's position relative to the standard, and on whether or not the province is included in the standard. The large number of tax bases included in the program further complicates matters, since no province lies below the standard for all tax bases.

Despite these difficulties, as discussed in section 2 many authors have expressed concern that the tendency of equalization entitlements to fall when tax bases rise may discourage provincial governments from adopting policies that encourage economic growth. In this paper we attempt to shed light on this issue with the help of simple five-variable VEC models of six provincial economies. While this approach has many limitations – the lack of a structural model which prohibits us from attributing the impulse responses to structural shocks, the small sample size, and the high level of aggregation of the data which renders it impossible to test for the potential substitution effects of equalization – it nonetheless yields

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[29] Recall that we do not explicitly model any of the changes to the equalization program during the sample period. With respect to the extremely large long-run increase in equalization payments in Quebec, it is of interest to note that this increase is probably not the product of special arrangements between the Federal and Quebec governments. While many such arrangements do exist, most have a greater effect on other federal-provincial transfers than on equalization.

some interesting observations that are relevant to discussions of the so-called "tax-back" effect.

For the most part, our GIR analysis does not appear to support the hypothesis that the tax-back effect poses a serious deterrent to the adoption of policies that foster economic growth. Nonetheless, we do find that positive shocks to the real per capita spending equation may have tended to result in long-run increases in equalization but little or no increase in GDP in five of the six provinces. Only in Nova Scotia do shocks to the spending equation seem to have been positively correlated with sizeable long-run increases in per capita GDP. While these results are certainly consistent with a spending policy that focuses less on economic growth than on other objectives in five of the six provinces, it is also possible that our dynamic models simply do not include enough lags to capture the full effect of government spending policies.

However, our analysis of the effects of shocks to the revenue equation suggests that while such shocks do appear to have been associated with increases in average tax rates in some provinces, they do not appear to have had a detrimental effect on per capita GDP. In fact, contrary to our expectations, increases in revenues and GDP occurred simultaneously in four of the six provinces. Although we cannot on the basis of our results say anything about whether average tax rates are higher than they would have been in the absence of equalization, the results do suggest that the aggregate tax base is not very elastic, which would tend to reduce the distortionary consequences of the tax-back effect, should those exist.

Finally, we find no evidence that equalization itself has had a negative effect on GDP growth. Over the period of our analysis, shocks to the equalization equation have been associated with long-run increases in equalization payments, but have had little or no effect on GDP. It is of course possible that GDP growth in the provinces examined might have been higher in the absence of equalization. But it appears unlikely that provinces are making decisions that have significant detrimental effects on provincial economic growth and the welfare of their citizens. As well, we cannot on the basis of this analysis rule out the possibility that provinces may make strategic decisions not about the level of taxation, but rather the sources, in line with the incentives to do so provided by the current equalization system. This is a question that must be left to future research. What we can say is that during the 1963-1998 period, Canada's RTS equalization program does not appear to have had an overall negative effect on economic growth.

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Appendix: Data Definitions and Sources

Var.	Constructed using:	Manitoba	Quebec	N.B.	N.S.	P.E.I.	N&L	Ontario
Y	Total provincial GDP, expenditure based	D24434 D31852	D31808 D24363	D31786 D24329	D31764 D24295	D24261 D31742	D24227 D31720	D24397 D31830
YO	Total provincial GDP of the 9 province group that excludes the given province	Constructed using above data and corresponding data for non-recipient provinces.						
F	Total federal transfers to provinces (before netting E)	D28252 D43089	D28206 D43033	D28183 D43005	D28160 D42977	D28137 D42949	D28114 D42921	D28229 D43061
R	Provincial own-source revenues (before netting F)	D26240 D12956	D26194 D12916	D26171 D12896	D26148 D12876	D26125 D12856	D26102 D12836	D26217 D12936
E	"Taxation Agreements" i.e. Eq. Payments plus prior-year adjustments, stabilization payments and other[30].	D43093 D28241	D28195 D43037	D28172 D43009	D28149 D42953	D28126 D42953	D28103 D42925	
S	Total provincial expenditures	D26247 D12964	D26201 D12924	D26178 D12904	D26155 D12884	D26132 D12864	D26109 D12844	D26224 D12944
	Total local expenditures	D26514 D13161	D26476 D13127	D26457 D13110	D26438 D13093	D26419 D13076	D26400 D13059	D26495 D13144
	Less transfers between levels	D26245 D26512 D13165 D12969	D26199 D26474 D13131 D12929	D26176 D26455 D13114 D12909	D26153 D26436 D13097 D12889	D26130 D26417 D13080 D12869	D26107 D26398 D13063 D12849	D26222 D26493 D13148 D12949

Note: All variables are in real per capita terms. Data series on provincial population are readily available through CANSIM. We use the national GDP deflator for provincial GDP due to a lack of a provincial substitute that covers the period in question (d15612). Statistics Canada has recently converted from a referencing system of "d-numbers" to "v-numbers". We continued to work with the d-numbers out of simplicity, but for future reference these identifiers can be translated over to the new system through an algorithm available on the CANSIM II website, http://cansim2.statcan.ca/ .

The data was obtained from two sets of Provincial Economic Accounts (PEA) data that were non-continuous over the period (1961-1991, and 1981 to 1998). A linking formula was applied which took the growth rate of the historical series to extend the current one, in order to better justify merging the series. In any case, differences between the historical and current series were minimal.

[30] Also included in this category are special payments to Alberta re: public utilities. They are very small and are not expected to bias results.